This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

3 3433 07599381 0

A GRADUATED COURSE

OF SIMPLE

MANUAL TRAINING EXERCISES

5/16/12 [illegible]

A GRADUATED COURSE

OF SIMPLE

ANUAL TRAINING EXERCISES

FOR EDUCATING

THE HAND AND EYE

BY

W. HEWITT, B.Sc.

LATE SCIENCE DEMONSTRATOR FOR THE LIVERPOOL SCHOOL BOARD

PART II.

CONTAINING THE THIRD AND FOURTH SERIES

LONDON

LONGMANS, GREEN, & CO.

AND NEW YORK: 15 EAST 16th STREET

1893

All rights reserved

S. [illegible]

THE NEW YORK
PUBLIC LIBRARY
588967
ASTOR, LENOX AND
TILDEN FOUNDATIONS.
R 1913 L

371.42

PREFACE.

THE present volume contains the second part of a course of simple Manual Training Exercises, drawn up at the request of the Liverpool School Board, and introduced into nearly all their schools. A previous volume (Part I.) contained a First and Second Series of exercises, intended for children of from seven to nine years of age (Standards I. and II.); while the present part contains the Third and Fourth Series of the course, intended for children from nine to eleven years of age (Standards III. and IV.), who have worked through one or both of the preceding series.

The general principles upon which the course has been drawn up were explained in the Introduction to Part I., and it does not appear necessary to state them again here. The exercises in the First and Second Series were designed to lead up to those in the later series, which are drawn up on similar lines, but require somewhat more skill and patience on the part of the children.

The exercises have again been largely based upon the course of drawing taken by the same standards in the schools, and the two subjects will be found to mutually assist each other. In the Fourth Series especially it is intended that each exercise shall be drawn on paper accurately to scale, and the form or model then constructed to the same scale in wire or cardboard.

While it is desirable that the children should be taken through the complete series of exercises in proper order, so a[illegible]e full educational advantage of the course, it i[illegible]sible and easy for a teacher to further extend and

13306

develop with advantage any particular set of exercises clay modelling, wire work, cardboard modelling, etc which either the teacher or the children are partici interested.

There should be no difficulty in obtaining materials sui for use in the exercises; but it might be mentioned Messrs. Philip, Son, and Nephew, of South Castle S Liverpool, have specially arranged most of the materia a form to meet the wishes of the author.

W. HEWIT

LIVERPOOL,
September, 1893.

CONTENTS.

THIRD SERIES.

PAGE

List of Apparatus and Materials 129

Notes on the Apparatus and Materials 130

Exercises 132

FOURTH SERIES.

List of Apparatus and Materials 189

Notes on the Apparatus and Materials 190

Exercises in Wire Modelling 193

Exercises in Cardboard Cutting 205

Exercises in Cardboard Modelling 218

THIRD SERIES.

LIST OF APPARATUS AND MATERIALS.

[Those marked with * are the same as used in an earlier series.]

Cartridge drawing paper, pieces about 11″ × 7″. (*Note J*, p. 130.)
* Large white paper squares, 6″ side.
* Squared drawing paper (¼″ squares), pieces 5″ square.
* Coloured (various) paper squares, 4″ side; gummed on back. (*Note D*, Part I. p. 4.)
* Rule 12″ long, marked in eighths.
Small set square, with angles 60° and 30°.
* Lead pencil.
* Scissors. (*Note C*, Part I. p. 4.)
* Series of various coloured wools in bag. (*Note E*, Part I. p. 5.)
* Teacher's corresponding series of wool skeins.
* Box of crayons, with holders and stumps. (*Note I*, Part I. p. 68.)
* Modelling clay. (*Note G*, Part I. p. 6.)
* Earthenware vessel with lid, for holding moist clay.
* Modelling board.
* Modelling tool. (*Note H*, Part I. p. 7.)
* Small square wood blocks, for working clay, 3″ side by ½″ thick.
Small sponge.
* Circular disc, 3″ side, by preference of metal. (Compasses with pencil leg may be used instead.)
Iron wire, pieces 1 foot long. (*Note K*, p. 130.)
Small flat pliers. (*Note L*, p. 130.)
* Drawing pins.
* Thin string.
* Pins.

NOTES ON THE APPARATUS AND MATERIALS, AND THEIR USE.

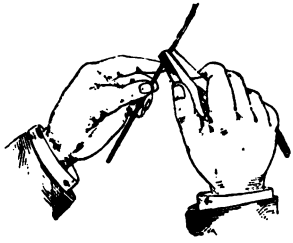
Notes on some of the materials which have been used in the First and Second Series of exercises will be found in Part I., and should be consulted.

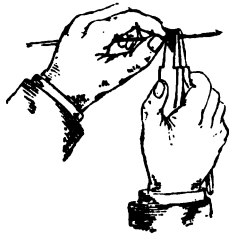
(*J*) *Cartridge drawing paper.*—Ordinary drawing paper will do, but it should be stout enough for making simple paper models. For some exercises, pieces half the size given in the preceding list are required, but the larger pieces are readily folded and torn or cut in two with a paper-knife.

(*K*) *Iron wire.*—This should be about No. 18 in thickness, and cut into pieces 1 foot long. It may be had in bundles containing about two hundred such pieces. It need scarcely be said that it should be kept in a dry place to prevent it from getting rusty.

(*L*) *Small flat pliers.*—These are for use in bending and breaking the iron wire, and should not be too large for the children to hold and use comfortably.

To bend the wire, it should be held in the pliers with the point at which it is to be bent close to one edge of the pliers; the bending should then be done by the pressure of the forefinger or thumb as close to the pliers as possible, as in the accompanying figures.





The wire can also be straightened by means of the pliers, if necessary.

In order to break the wire at any point, it should be held firmly with the pliers close to the point, and then bent backwards and forwards several times.

Exercise I.

DRAWING WITH SET SQUARE, AND CUTTING.

MATERIALS.—*Cartridge paper (half-sheet); rule; set square; lead pencil; scissors.*

Rule line 4″ long near shorter edge of paper.

Draw perpendicular 4″ long at each end of line, by help of set square. (To do this, hold ruler firmly against line, place proper edge of set square against ruler (Fig. 1), and slide it along to proper point; then remove ruler, meanwhile holding set square firmly in position.)

Join ends of perpendiculars by a line, and measure its length.

Cut out square with scissors.

Let children then by themselves construct another (smaller) square on remainder of paper, and cut out.

[If there is time, rule diagonals of the larger square, cut it up into four triangles, and lay these together (as shown in Fig. 3) to form two complete squares, noting the right angles and half right angles.]

FIG. 1.

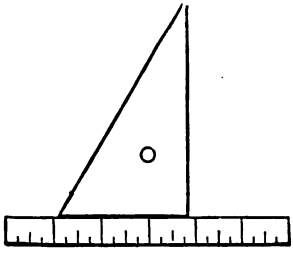


FIG. 2.

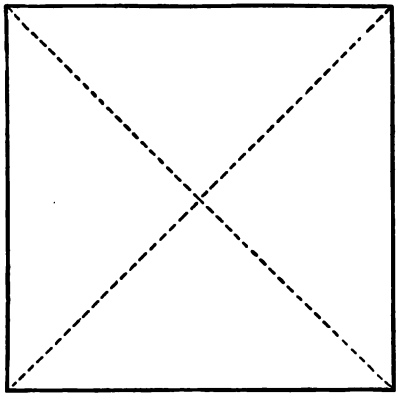
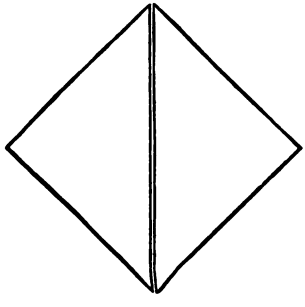


FIG. 3.

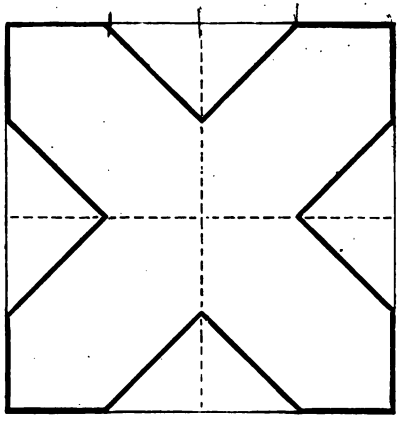


Exercise II.

DRAWING WITH SET SQUARE, AND CUTTI:

MATERIALS.—*Cartridge paper (half-sheet); rule; set square scissors.*

Draw square of 4″ side, as in last exercise.
Find by measurement middle points of sides, and site points.
Find by measurement middle point of each side small squares.
Rule lines joining marked points, as in figure. (on blackboard.)
Thicken lines of cross (see figure).
Cut out cross along the thickened lines.



Exercise III.

DRAWING WITH SET SQUARE, AND CUTTING.

MATERIALS.—*Cartridge paper (half-sheet); set square; rule; lead pencil; scissors.*

Rule line 4″ long near one edge of paper.

Use set square to draw line at angle of 60° from each end of first line, forming a triangle (Fig. 1).

Cut out triangle, and measure sides to prove equilateral.

Children then by themselves construct and cut out similar triangle with sides 3″, and another with sides 2″.

Compare the three triangles with each other, to show all angles equal (Fig. 2).

[A triangle might also be constructed, using the other angle of the set square (*i.e.* 30°), to show that it will not be equilateral.]

FIG. 1.

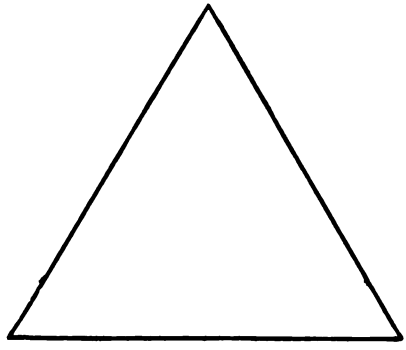
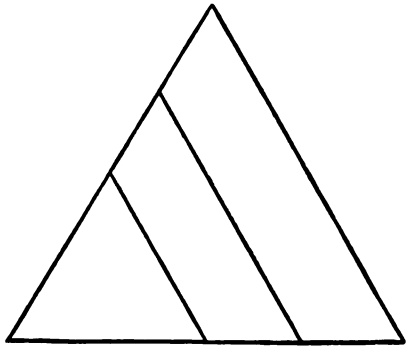


FIG. 2.



Exercise IV.

DRAWING AND PAPER MODELLING.

MATERIALS.—*Cartridge paper (half-sheet); rule; lead pencil; set square; scissors.*

Rule line 6″ long near one long edge of paper (or mark distance on edge itself, if straight).

Construct an equilateral triangle on this line by means of set square, as in last exercise.

Cut out the triangle.

Measure length of each side of triangle, and mark middle points of sides.

Rule lines joining middle points (Fig. 1).

Measure lines last drawn, to show new figure is also equilateral triangle.

Note the four similar and equal triangles.

Fold large triangle accurately along pencil lines, bend over each outer triangle on to central one, and crease carefully. (This will test accuracy of drawing and folding.)

Place three outer triangles to meet in point forming a regular tetrahedron (Fig. 2)

FIG. 1.

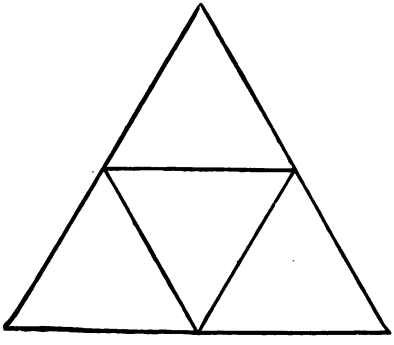
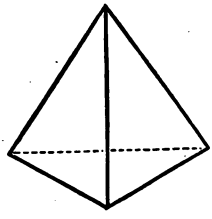


FIG. 2.



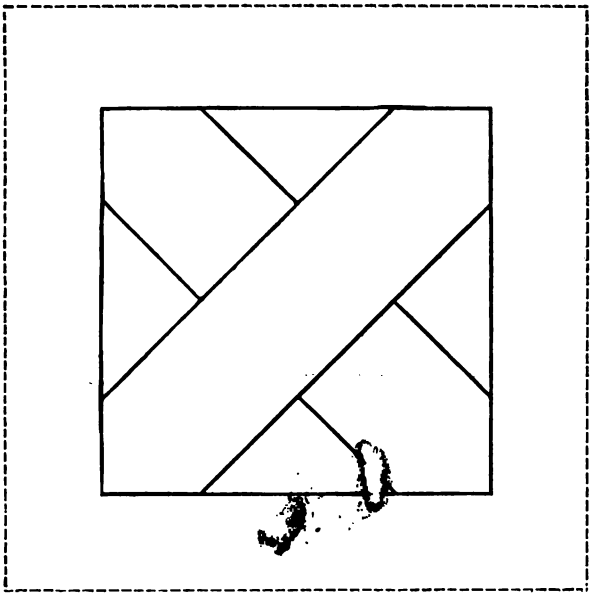
THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS.

Exercise VI.

DRAWING AND COLOURING.

MATERIALS.—*Large white paper square; rule; set square; lea crayons.*

Measure size of paper square with rule.
Draw line 4″ long, about 1″ distant from one edge of and leaving same space at each end.
On line drawn construct a square, as in Exercise I.
Mark points on each side of drawn square distant corner.
Join marked points (as in figure) by faint lines to form a letting one arm appear to lie over other.
Colour two arms of cross with different coloured crayon
Thicken lines bordering coloured portions.



Exercise VII.

CLAY MODELLING.

MATERIALS.—*Moist clay; modelling board; small square wooden block; damp sponge; thin string (or wire) for cutting clay.*

Make piece of clay into cube, by striking it with small wooden block, and against surface of modelling board.

Convert clay cube into a sphere by first flattening the corners against the board, and then rolling it between the block and board or in the hands.

Cut clay sphere into six approximately equal parts, and roll each piece to form a ball. (Compare the sizes of the six balls.)

NOTE.—If the clay gets dry while working, the hands may be occasionally moistened with the damp sponge, but not so as to make the clay sticky. The quantity of clay given to each child should not be too small. (See *Note G*, Part I. p. 6.)

Exercise VIII.

CLAY MODELLING.

MATERIALS.—*Moist clay (large-sized piece); modelling board; modelling tool; damp sponge.* [*Orange and lemon, or models of same.*]

Divide clay into two nearly equal portions, and roll each into sphere.

Model one piece into form of orange, after examination of form of fruit. (Note departure from true sphere, etc.)

Model second piece into form of lemon, after examination of fruit; noting how it differs from true sphere and from orange.

Imitate roughness of fruits by slightly indenting clay with point of modelling tool.

Exercise IX.

CLAY MODELLING.

Materials and steps same as in last Exercise, using apple and pear (or models) instead of orange and lemon.

FIG. 1.

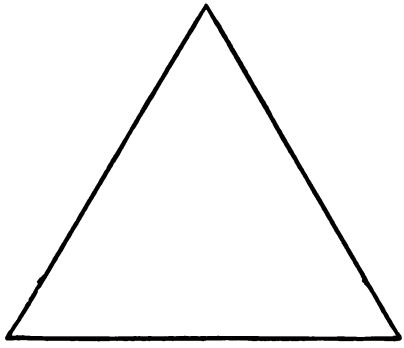
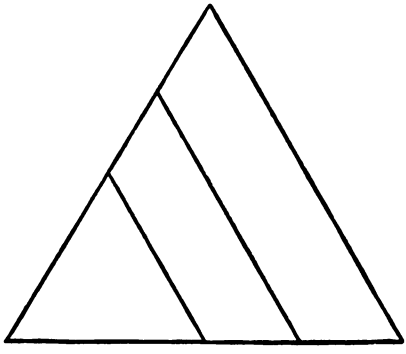
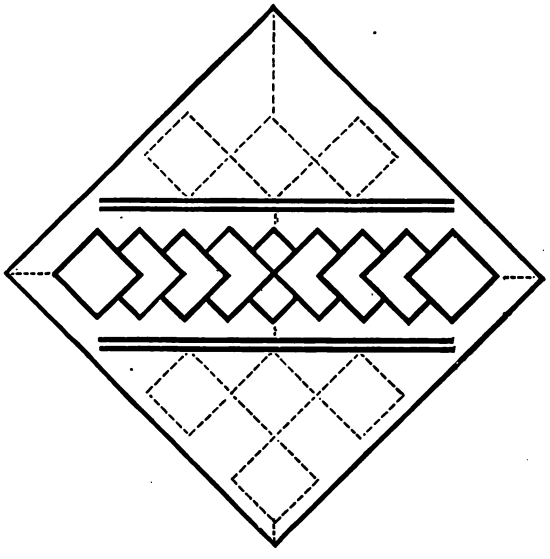


FIG. 2.





Exercise X.

CUTTING PAPER AND MOUNTING.

MATERIALS.—*Coloured gummed paper square; large white paper square; lead pencil; ruler; scissors; damp sponge.*

Fold coloured square twice at right angles (coloured side inwards), to make four smaller squares.

Crease, open out, and cut carefully along crease-lines.

Fold each small square into four, crease, and cut.

Select nine well-cut squares for mounting.

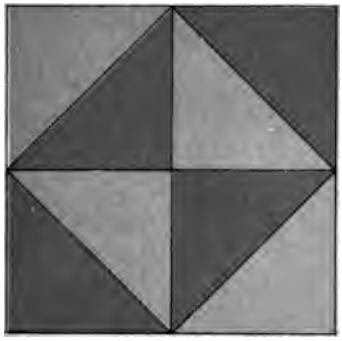
Rule diagonals faintly on white paper square.

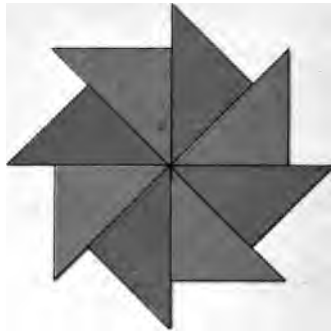
Mount one small coloured square symmetrically in centre of white square, with its angles on the diagonals. (A piece of paper might be supplied to the children to lay over the coloured squares while pressing them down in mounting.)

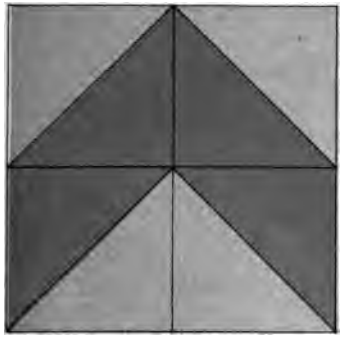
Mount four small squares on each side of first, along one diagonal, each square overlapping to middle of preceding one.

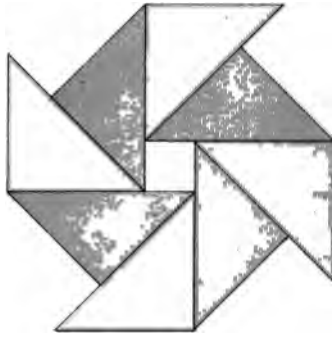
Rule parallel lines nearly touching corners of small squares.

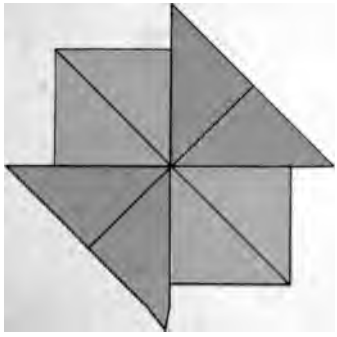
[Let children lay the remaining squares symmetrically according to their own design, *e.g.* as shown by dotted lines in figure, and mount approved designs.]

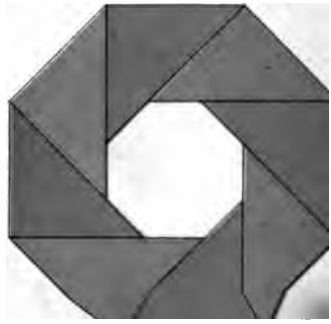








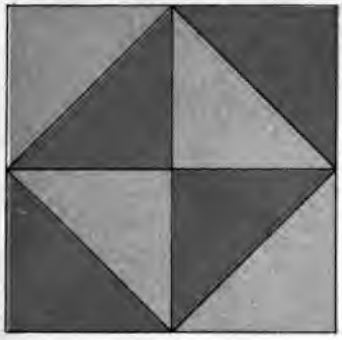


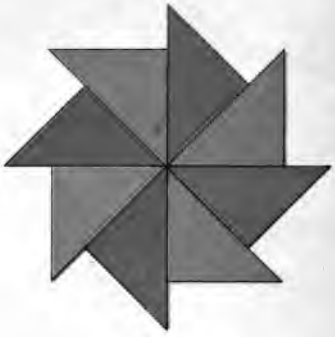


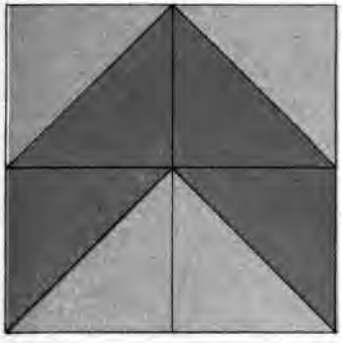
THE NEW YORK
PUBLIC LIBRARY

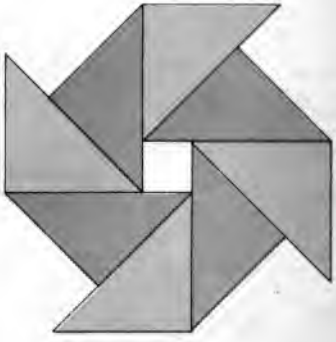
ASTOR, LENOX AND
TILDEN FOUNDATIONS.

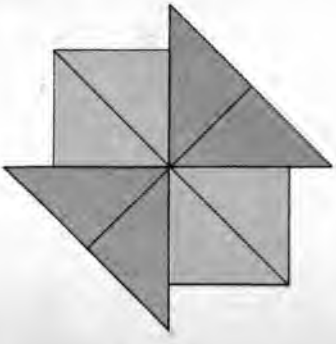
Plate 1.

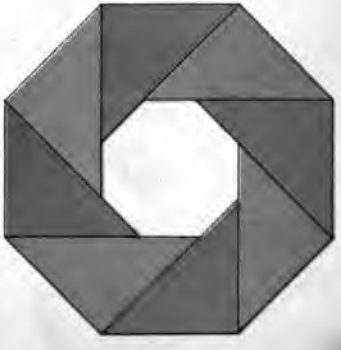


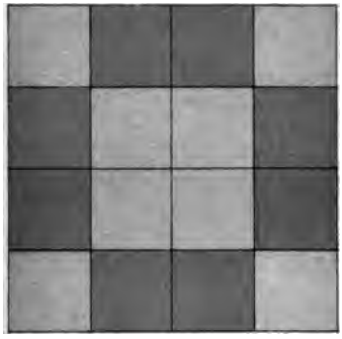


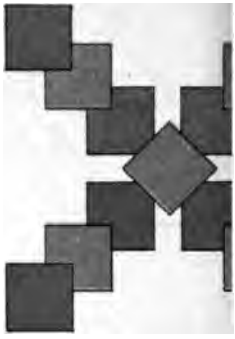


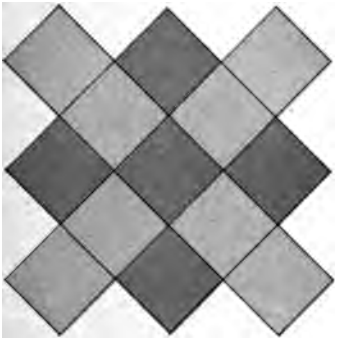


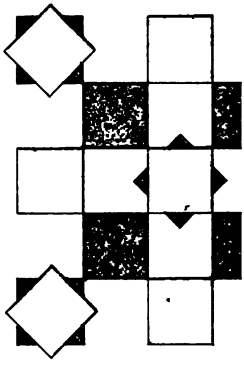


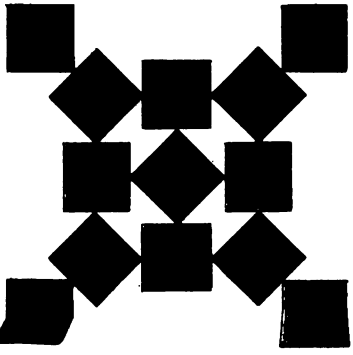


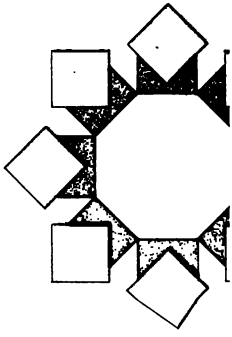












Exercise XII.

DESIGNING AND MOUNTING (PLATE II.).

MATERIALS.—*Coloured gummed paper square (each pair of children having colours that go well together); large white paper square; scissors; damp sponge.*

Fold coloured square into four smaller squares; crease, open out, and cut.

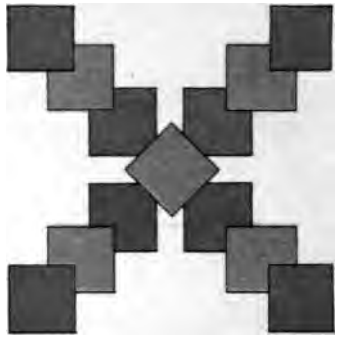
Change two squares with neighbour for two of another colour.

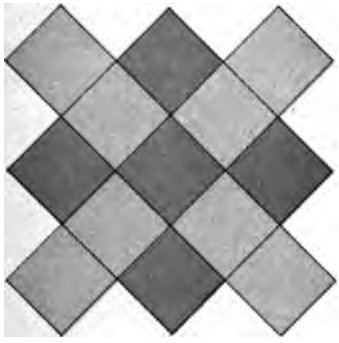
Fold each square again into four smaller squares, and cut, to get sixteen squares in all.

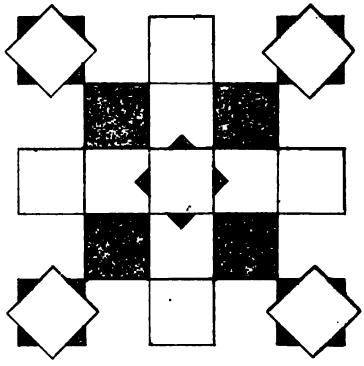
Children lay pattern of their own design on white paper square, with from ten to sixteen pieces of two colours.

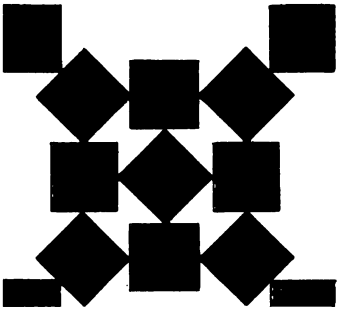
Mount approved designs on white paper square (faintly ruling diagonals or middle lines, if necessary, to help in the mounting).

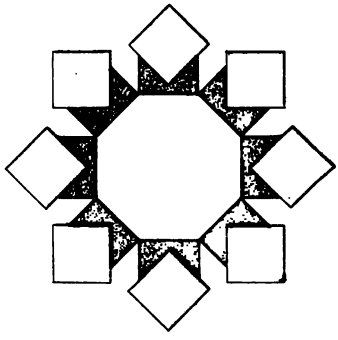
[The children should be again left as much as possible to themselves, and not shown previously prepared patterns until they have first tried without such aid. And even when the patterns have been shown, they should be again laid aside, and the children encouraged to reproduce them from memory. Examples of patterns formed from such pieces are shown on Plate II.]











Exercise XII.

DESIGNING AND MOUNTING (PLATE II.).

MATERIALS.—*Coloured gummed paper square (each pair of children having colours that go well together); large white paper square; scissors; damp sponge.*

Fold coloured square into four smaller squares; crease, open out, and cut.

Change two squares with neighbour for two of another colour.

Fold each square again into four smaller squares, and cut, to get sixteen squares in all.

Children lay pattern of their own design on white paper square, with from ten to sixteen pieces of two colours.

Mount approved designs on white paper square (faintly ruling diagonals or middle lines, if necessary, to help in the mounting).

[The children should be again left as much as possible to themselves, and not shown previously prepared patterns until they have first tried without such aid. And even when the patterns have been shown, they should be again laid aside, and the children encouraged to reproduce them from memory. Examples of patterns formed from such pieces are shown on Plate II.]

Exercise XIII.

WIRE MODELLING.

MATERIALS.—*Stout iron wire, about 12″ long; rule; flat pliers; lead pencil; white paper square.* (See *Notes K, L*, p. 130.)

Rule lines on paper, making right angle, obtuse angle, and acute angle respectively.

Measure piece of wire 2″ long, hold close to that point with pliers, and break wire by bending it backwards and forwards several times.

Break remainder of wire into pieces 2″ long in same manner.

Hold one small piece of wire at middle point by pliers, and bend there to form right angle. Lay bent wire over drawing on paper, to test accuracy.

Bend second piece of wire to form obtuse angle, and third piece to form acute angle, equal in each case to angles previously drawn. Lay bent wires over drawing, to test.

Bend remaining pieces of wire at point about one-third distance from one end, to form angles same as before; and lay on paper parallel to others (see figures).

FIG. 1.

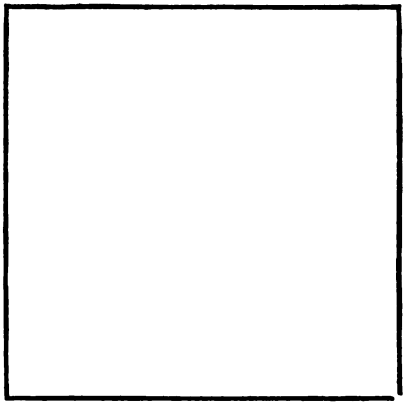
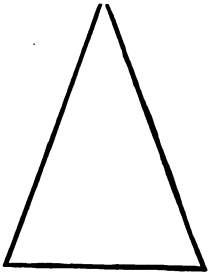


FIG. 2.



Exercise XIV.

WIRE MODELLING.

MATERIALS.—*Iron wire; rule; pliers; white paper square; set square; lead pencil.*

Measure piece of wire 8″ long, break off, and use for following steps.

Find point 2″ from end of wire; bend sharply there to form right angle.

Bend wire at right angles at other points 2″ apart, to complete square. (Make square so as to lie flat on desk or table.)

[If there is time, a square of 2″ side should be drawn, by aid of set square, on piece of paper, and wire square laid on it for comparison.]

Measure remaining piece of wire.

Find points at which to bend wire to form a triangle having base 1″ long and two sides equal to each other.

FIG. 1.

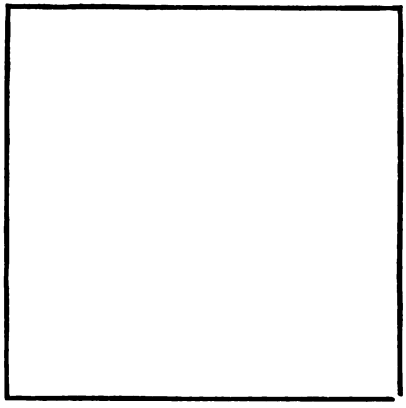
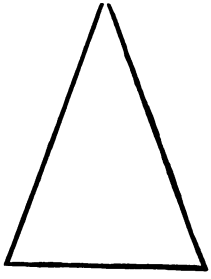


FIG. 2.



Exercise XV.

WIRE MODELLING.

MATERIALS.—*Iron wire; pliers; white paper square; set pencil; rule.*

Draw on white paper an oblong (rectangle) having 3″, and short sides 1½″.

Break off length of wire required to construct equal figure.

Bend wire at right angles, at measured distanc oblong.

Lay wire model over drawing for comparison.

Measure remaining piece of wire, and bend to form triangle.

FIG. 1.

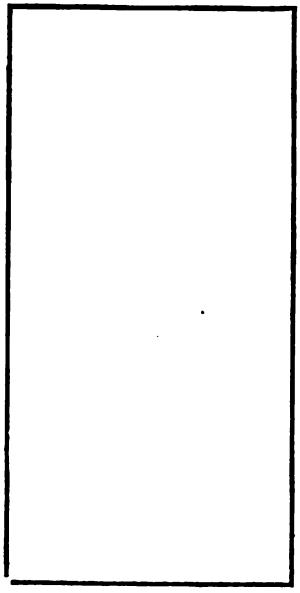
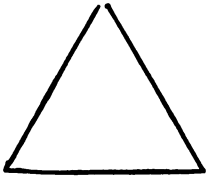


FIG. 2.



Exercise XVI.

DRAWING, CUTTING, AND MOUNTING.

MATERIALS.—*Squared paper; lead pencil; ruler; coloured gummed paper square; large white paper square; scissors; pin; damp sponge.*

Rule on squared paper a square with side fourteen units (squares) long.

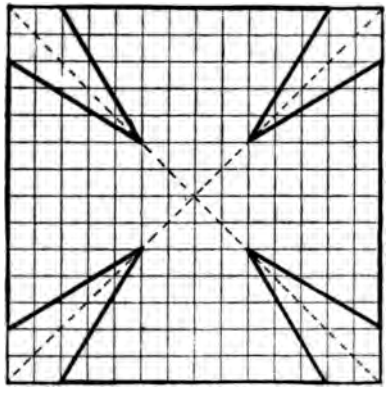
Rule faintly diagonals of square, and on diagonals mark points distant two squares from their point of intersection.

Mark points on sides of square distant two squares from the corners, and rule lines from these points to those previously marked on diagonals, to form Maltese cross (see figure).

Lay drawing on coloured paper square, and prick through with pin all corner-points of the figure. (Hold the drawing firmly in position with one hand while this is being done.)

Rule lines on front or back of coloured paper square, joining pricked points, to reproduce the figure.

Cut out figure carefully with scissors, and mount on white paper square. (First lay cut-out figure in proper position on white square, and mark two or three corner-points with pencil, so as to guide in mounting it after being damped.)



Exercise XVII.

DRAWING, CUTTING, AND MOUNTING.

MATERIALS.—*Squared paper; lead pencil; ruler; coloured gummed paper square; large white paper square; scissors; pin; damp sponge.*

Rule on squared paper a square with side of sixteen units, and rule diagonals of square.

Mark points on diagonals at distance of four squares from their intersection, and rule lines from those points to the corners of the square (see figure).

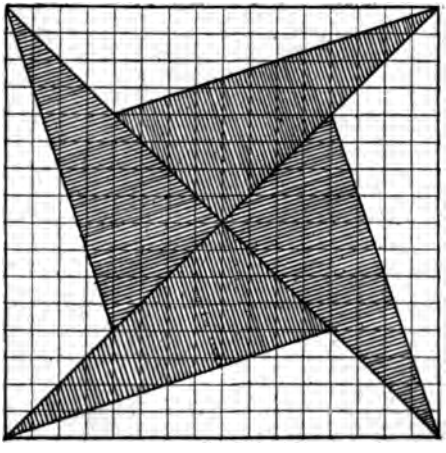
Lay drawing on coloured gummed square, and prick through the corners of *one* of the triangles meeting in the middle of the square.

Rule lines on coloured square joining pricked points, and cut out the triangle.

Cut out three other similar triangles (using the one first cut out as a pattern, or pricking through the points as before).

Mount the four coloured triangles symmetrically on white paper square, to reproduce drawn figure.

NOTE.—It is intended that the four triangles should be separately drawn and cut out, as a test of accurate work, rather than that the figure should be drawn and cut out as a whole.



Exercise XVIII.

DRAWING AND COLOURING.

MATERIALS.—*Squared paper; ruler; lead pencil; large white paper square; pin; crayons.*

Rule two lines across paper, parallel to each other, and twelve squares apart.

Mark off points at distance of twelve squares from same end of each of above lines, and join points to form a square with side of twelve units.

Divide each side of this small square into three equal parts, and rule lines to form Greek cross (Fig. 1, A).

Draw Latin cross (Fig. 1, B) with upright and arms having breadth of three squares, and with arms projecting distance equal to two squares.

Lay drawing on white paper square, and prick through corners of Greek cross; rule lines joining points, so as to reproduce figure.

Do the same with the Latin cross, but arrange so that the two crosses on the white paper are separated by a space (Fig. 2).

Colour the figures with crayons.

FIG. 1.

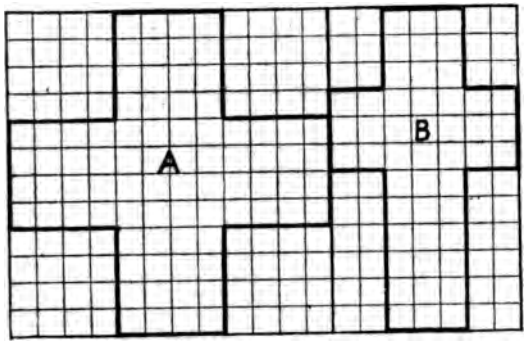
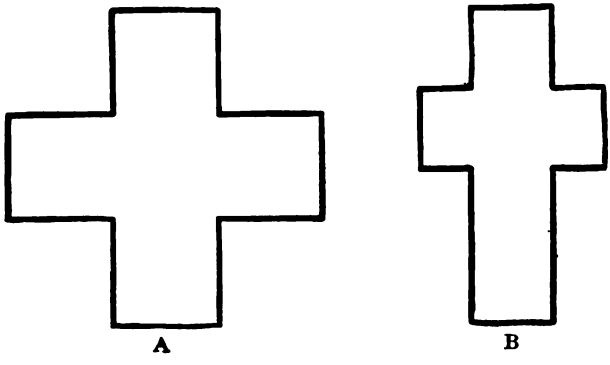


FIG. 2.



Exercise XIX.

DRAWING AND COLOURING.

MATERIALS.—*Large white paper square; rule; lead pencil; set square; crayons.*

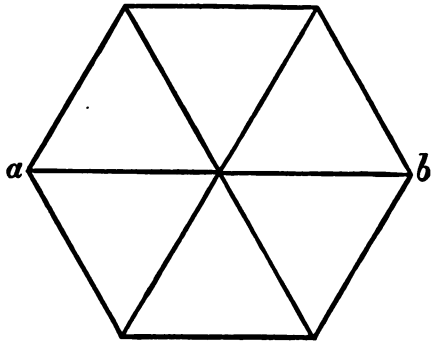
Rule line (*a b* in figure) 4″ long about middle of white paper square, and mark middle point of line.

Through middle point of line thus drawn rule lines of equal length (2″ on each side middle point), making angles of 60° with it, by means of ruler and set square.

Join ends of lines to form hexagon. Note six equilateral and equal triangles.

Colour triangles of hexagon in two or three colours, and then rule strongly the lines of the triangles.

[The equality of the triangles might be tested by pricking through points of *one* small triangle to second piece of paper, carefully ruling lines joining the points, and cutting out the triangle so drawn with scissors. This triangle might then be applied in succession to the six triangles forming the hexagon.]


a
b

Exercise XX.

CLAY MODELLING.

MATERIALS.—*Moist clay; modelling board; small square wooden block; thin string to cut clay; rule; lead pencil; piece of paper.* [*Eight small wooden cubes for teacher's illustration.*]

Make clay into cube, as in Exercise VII., making edges and corners as sharp as possible.

Measure various edges of cube with rule, and write down lengths on paper.

Cut cube with thin string into eight smaller cubes, as shown by dotted lines in Fig. 1. (This might be illustrated by the teacher building up a cube out of eight small wooden cubes.)

Measure edges of small cubes, and write down measurements on paper.

Lay cubes of clay in two rows of four each, to form oblong block (Fig. 2); measure dimensions of block as to length, breadth, and thickness, and write down measurements on paper.

FIG. 1.

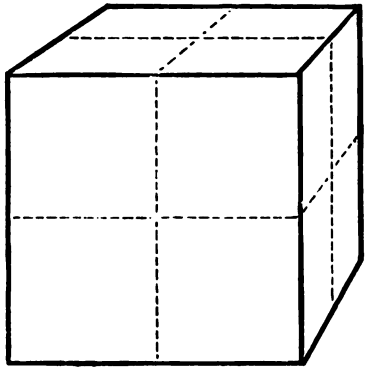
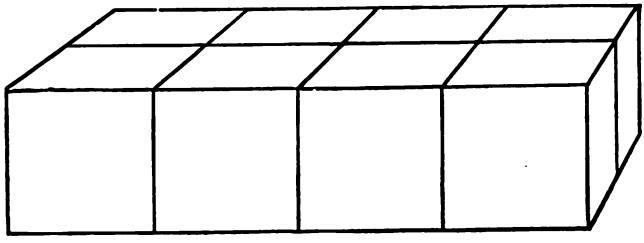


FIG. 2.



Exercise XXI.

CLAY MODELLING.

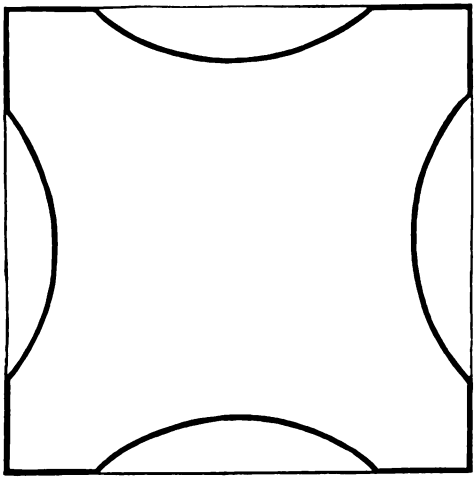
MATERIALS.—*Moist clay (somewhat less than in previous modelling board · small square wooden block · modelling sponge.*

Flatten out clay on board, by help of small wooden form a good square slab.

Mark on the clay with the modelling tool fine lines jc middle points of the sides of the square.

Mark with tool symmetrical curved lines (see figure) of square from near its corners.

Cut out with the tool the pieces enclosed by the cur and neatly finish off the figure.



Exercise XXII.

CLAY MODELLING.

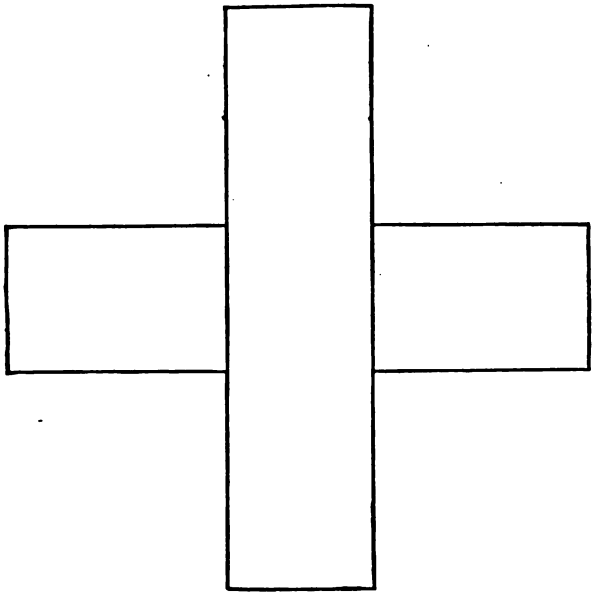
MATERIALS.—*Moist clay (about same quantity as in last exercise); n board; modelling tool; damp sponge; rule; small square block.*

Divide clay into two approximately equal portions.

Make up each piece of clay into rectangular block 4 and 1″ wide, by help of small wooden block.

Lay pieces on board to form a cross with equal arms-one block complete, and cutting pieces of proper from the other block to form the side arms. (The pieces might have their ends moistened to make adhere to the central strip.)

Measure distance from centre of cross to end of each a see if all arms are equal.



Exercise XXIII.

PAPER CUTTING AND MOUNTING.

MATERIALS.—*Coloured gummed paper square; model circular disc for pattern (or compasses, or string and drawing pin); lead pencil; ruler; damp sponge; large white paper square; scissors.*

Draw circle on back of coloured gummed paper square, either by tracing it round metal disc, or with pin and string or compasses.

Carefully cut out circle.

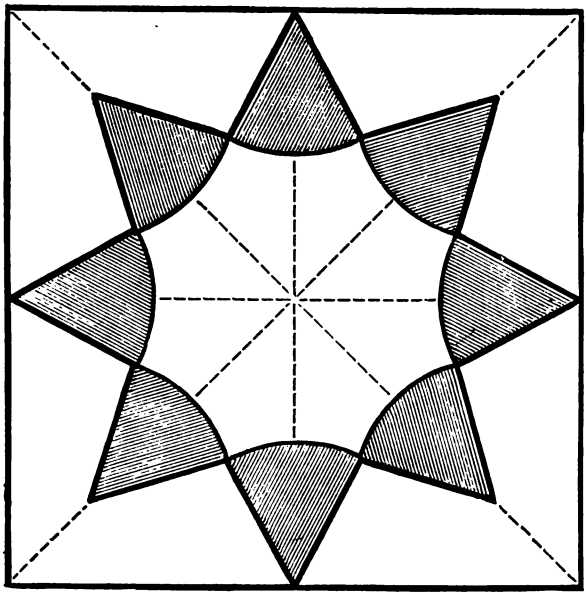
Fold paper circle along one diameter (coloured side inwards), and then again at right angles, to form four quadrants; crease well.

Cut out quadrants carefully along creased lines.

Fold each quadrant carefully along a radius into two equal parts; crease well, and cut along creased line.

Rule faintly on white paper square the diagonals and lines joining middle points of edges.

With the eight coloured sectors lay the design as in figure (which should be drawn on the blackboard), and then mount.



Exercise XXIV.

DESIGNING AND PAPER MOUNTING (PLATE III.).

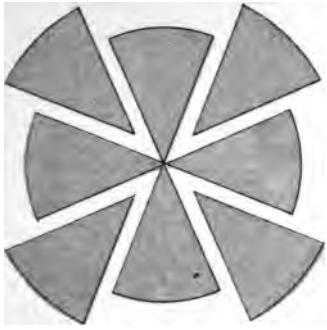
MATERIALS.—*Coloured gummed paper square; model circular disc (or string and drawing pin, or compasses); large white paper square; ruler: lead pencil; scissors; damp sponge.*

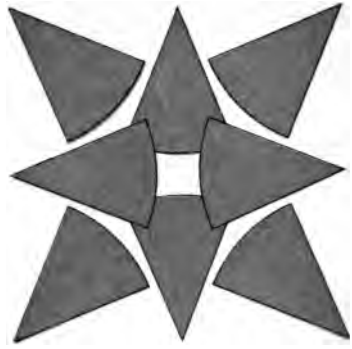
Outline circle on back of coloured gummed paper square; cut out circle, and divide into eight sectors, as in Exercise XXIII.

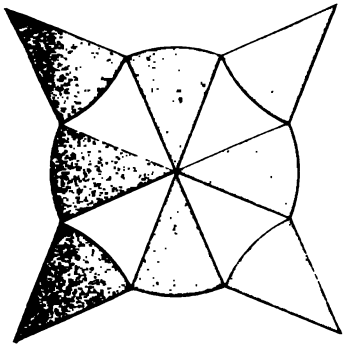
Children lay patterns of their own design with the eight sectors on white paper square.

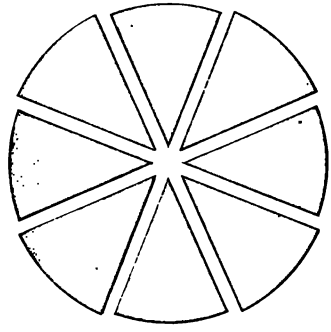
Mount approved patterns (using faintly ruled diagonals and middle lines of square, if necessary, as guides in mounting).

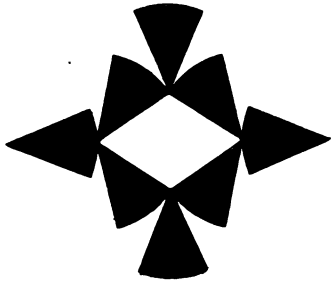
[Various patterns formed with the sectors are given in Plate III.]

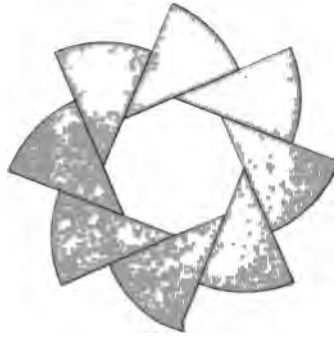












THE NEW YORK
PUBLIC LIBRARY
A C L NOX AND
TILD N FOUNDATIONS.

Exercise XXV.

PAPER MODELLING.

MATERIALS.—*Coloured gummed paper square; cartridge paper (half-sheet); damp sponge; rule; lead pencil; set square; scissors.*

Measure coloured paper square.

Draw on cartridge paper a square having side ½″ shorter than coloured paper square.

Cut out the drawn square.

Moisten one face of the cut-out square with the damp sponge, and lay it on the gummed side of the coloured square, leaving a margin on *three* sides, as shown in Fig. 1. (Let children first lay square in position before damping, to see that they understand the directions.)

Cut with scissors along the short dotted lines shown at *a* and *b* in Fig. 1; fold the narrow projecting strips of coloured paper, *a d* and *b c*, over the cartridge paper square, and fasten them down.

Bend the stiff paper carefully into a cylindrical form, and fasten the projecting gummed flap so as to keep the edges together, to form an open cylinder (Fig. 2).

[A completed cylinder, previously made, might be shown to the children at the beginning of the lesson, as the object about to be constructed.]

FIG. 1.

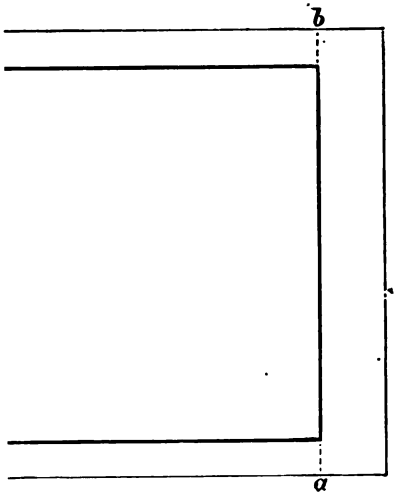
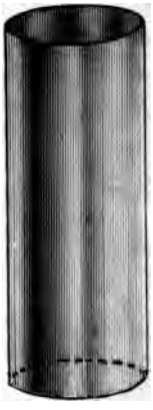


FIG. 2.



Exercise XXVI.

PAPER MODELLING.

MATERIALS.—*Cartridge paper (whole sheet); rule; set square, lead pencil; scissors; small strips of gummed paper, about* 2″ × ½″ e.g., *cut from gummed squares.* [*Paper cube, folded, but not fastened.*]

Show children paper cube previously prepared; open it out to show a plan of its six equal square faces, and draw sketch of plan on blackboard (Fig. 1).

Children draw on cartridge paper, by means of rule and set square, the "net" (or plan) for cube with side 2″ long. (Fig. 1 is not drawn full size, but the proper dimensions are marked.)

Cut round the *outside* lines of the figure when drawn.

Crease the cut-out figure neatly and accurately along the uncut lines, and fold it so as to make a cube (Fig. 2).

The loose edges of well-made cubes might be fastened together by means of the gummed strips, which should be first creased lengthwise down the middle.

NOTE.—These exercises in paper modelling are intended rather to illustrate the principle of constructing solid forms from previously drawn plane figures, and to lead the children to observe the relations of the various faces bounding the solid form, than as exercises in the production of finished models.

FIG. 1.

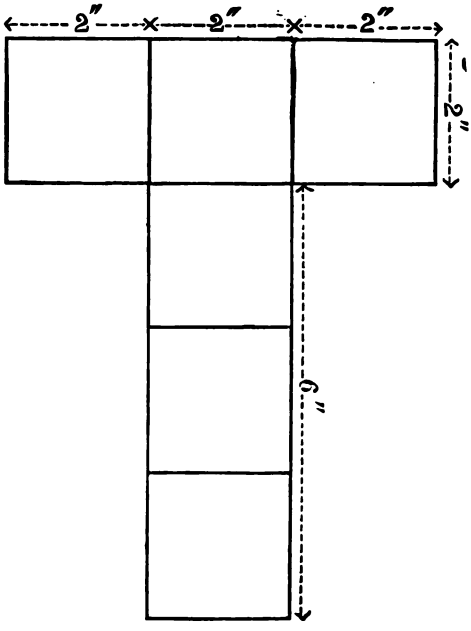
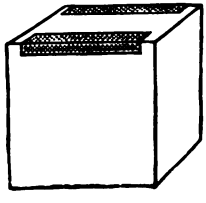


FIG. 2.



Exercise XXVII.

PAPER MODELLING.

MATERIALS.—*Cartridge paper (whole sheet); rule; set square; lead pencil; scissors; gummed paper strips.* [*Prism of stout paper, folded, but not fastened.*]

Show children the square prism previously prepared, and open it out to show its six faces.

Draw on blackboard the "net" for such a prism (Fig. 1).

Children draw on cartridge paper, to proper dimensions, net for square prism, having long sides 3″, and short sides 1½″.

Cut round the *outside* lines of the figure.

Crease the cut-out figure neatly and accurately along the pencilled lines, and fold together to form the prism (Fig. 2).

The loose edges of well-made prisms might be fastened with the gummed strips.

FIG. 1.

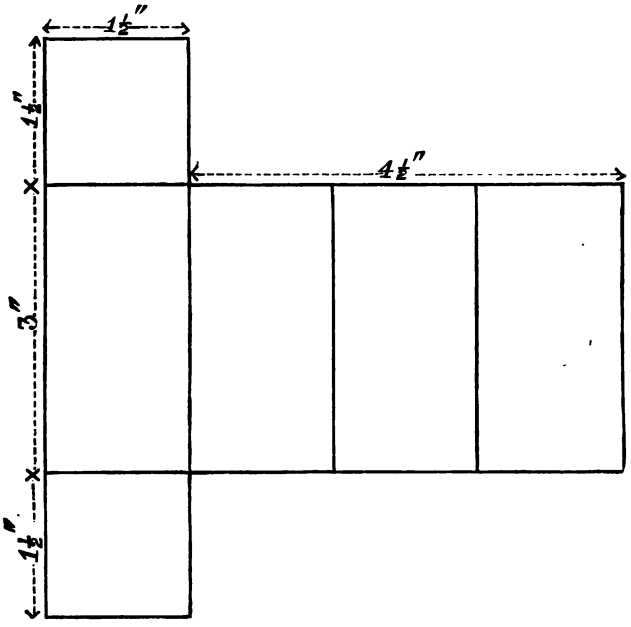
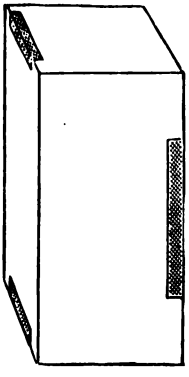


FIG. 2.



Exercise XXVIII.

PAPER MODELLING.

MATERIALS.—*Cartridge paper (half-sheet); lead pencil; rule; set square; scissors; gummed paper strips.* [*Triangular prism of stout paper, folded, but not fastened*]

Open out previously prepared model prism, to show its five faces.

Draw on blackboard the "net" for such a prism (Fig. 1).

Children draw on cartridge paper, to proper dimensions, net for triangular prism having long sides 3″, and short sides 1½″. (Draw the equilateral triangles by means of the set square with angle 60°.)

Cut round the *outside* lines of the figure.

Crease the cut-out figure neatly and accurately along the pencilled lines, and fold together to form the prism (Fig. 2).

The loose edges of well-made prisms might be fastened with gummed paper strips.

FIG. 1.

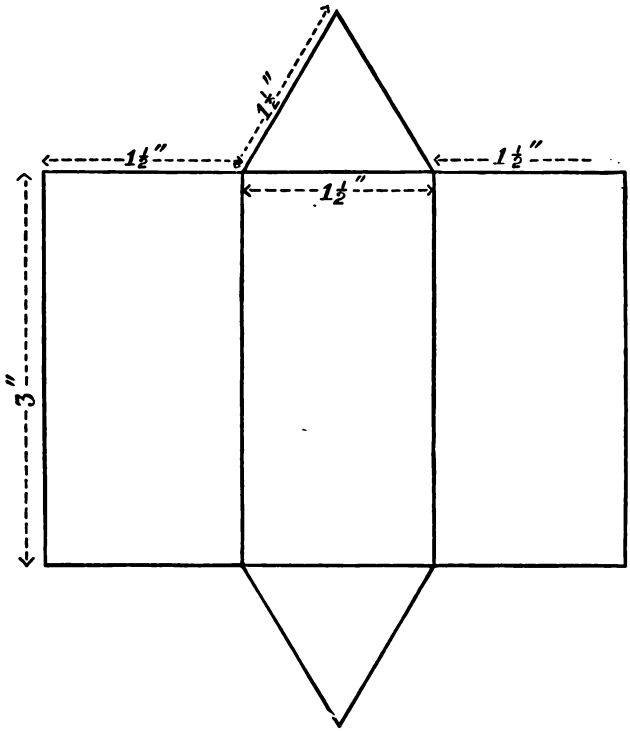
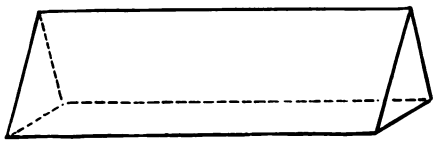


FIG. 2.



Exercise XXIX.

DRAWING CIRCLE AND ELLIPSE.

MATERIALS.—*Cartridge paper (whole sheet); sharp lead pencil; thin string about* 10″ *or* 11″ *long; ruler; two drawing pins; scissors.*

Tie small loop at each end of string, leaving length between loops about 6″ or 7″.

Put drawing pin through both loops, and fasten down through estimated middle point of paper; then with point of pencil in doubled part of string trace out a circle (Fig. 1).

Rule two diameters of circle at right angles to each other by estimation.

On other side of cartridge paper construct ellipse as follows:—

Rule line lengthwise at about middle of paper (Fig. 2, *a b*).

Mark on this line its estimated middle point, and also points at equal distances (say about 2″) on each side of it (Fig. 2, *c* and *d*).

Fasten drawing pin through loop of string at each of two latter points, and with point of pencil in angle of string (kept tight) trace out half-ellipse. Then lift string over pins, and trace out other half of ellipse.

Rule the axes of the ellipse, and note inequality.

Cut out the ellipse, and compare its form with that of a circle.

FIG. 1.

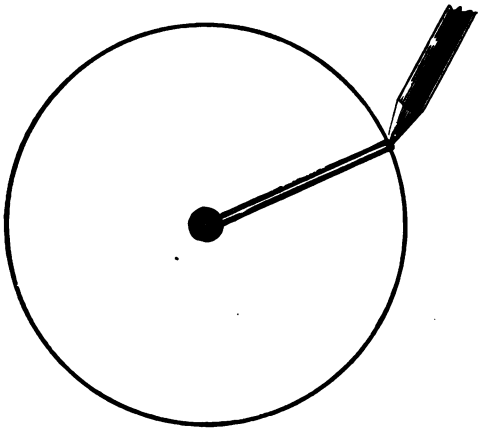
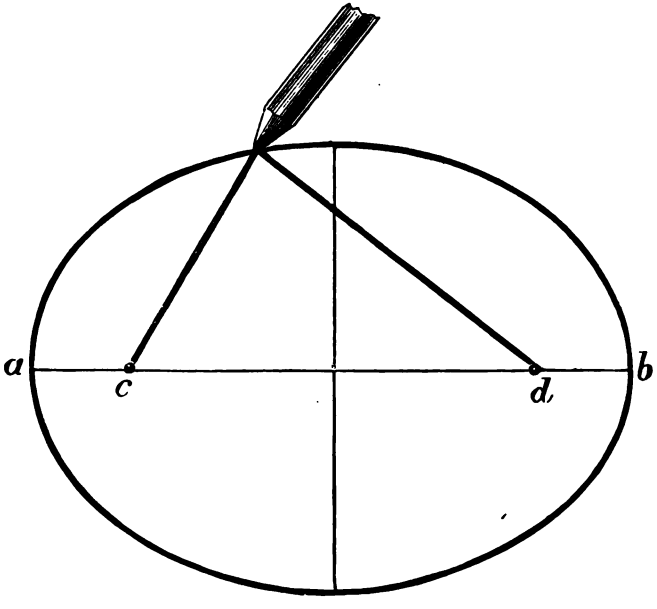


FIG. 2.



Exercise XXX.

PAPER CUTTING AND MOUNTING.

MATERIALS.—*Coloured gummed paper square; large white paper square; damp sponge; ruler; lead pencil; model circular disc (or string and drawing pin, or compasses).*

Draw outline of circle (as large as possible) on back of gummed paper square.

Carefully cut out circle.

Fold circle carefully twice at right angles (Fig. 1).

Cut carefully along a line (by estimation, without previously marking) parallel to curved edge of folded paper (*e.g.* the inner curved line of Fig. 1).

Open out the cut-off strip of paper, to show it is a circular ring.

Cut straight the (cut) edge of the folded paper (see dotted line in Fig. 1), and open out to show it is a square.

Rule faintly diagonals of white paper square, and mount ring and square symmetrically, as in Fig. 2.

FIG. 1.

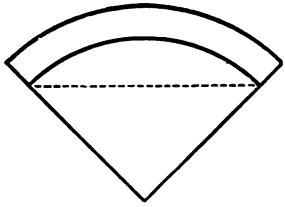
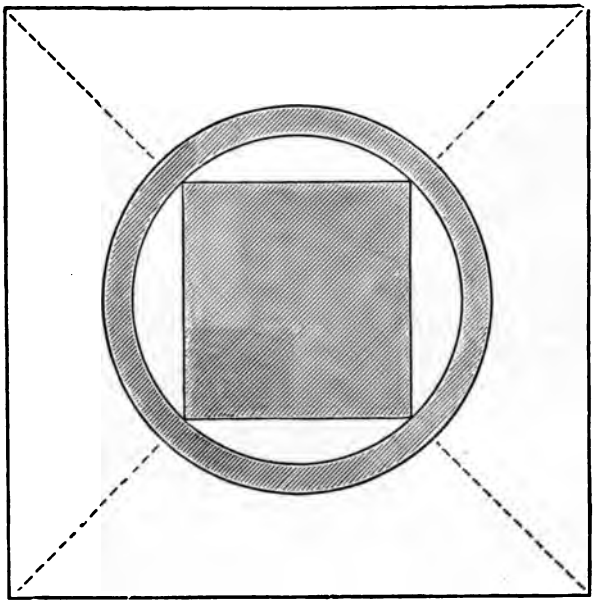


FIG. 2.



NEW YORK
PUBLIC LIBRARY

ASTOR, LENOX AND
TILDEN FOUNDATIONS.

FOURTH SERIES.

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS.

LIST OF APPARATUS AND MATERIALS.

[Those marked with * are the same as used in an earlier series.]

* Iron wire, pieces 1 foot long. (*Note K*, p. 130.)
* Small flat pliers. (*Note L*, p. 130.)
  Cardboard, in pieces 12″ × 8″, 8″ × 6″, and 6″ × 4″. (*Note M*, p. 190.)
* Board for cutting cardboard on (same as used for clay modelling).
  Small cutting knife. (*Note N*, p. 190.)
  Steel rule for use in cutting. (*Note O*, p. 191.)
  Gummed strips of bookbinder's cloth, about 1′ long, ½″ wide. (*Note P*, p. 191.)
* Drawing paper (some plain, and some divided into squares of ⅛″).
  Compasses (with pencil leg).
* Set square, with angles 60° and 30°.
* Rule, marked to eighths.
  Stout brown paper envelopes. (*Note Q*, p. 192.)

NOTES ON THE APPARATUS AND MATERIALS, AND THEIR USE.

The notes on the apparatus and materials which follow the lis for the Third Series, as well as those in connection witl the lists in Part I., should be consulted.

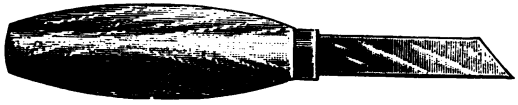
(*M*) *Cardboard.*—The cardboard must not be so stout as t make it very difficult for the children to cut it with th knife; but at the same time it should be stiff enough t enable it to keep its shape without bending. It shoul also not be such as to break off short when being ben in the modelling exercises. The cardboard suggested fo use in the following exercises is "four-sheet mountin board," which the children should be able to cut with proper knife without much difficulty. (It will be neces sary, however, for them to draw the knife two or thre times across the cardboard, in order to make a clean cut.

Cardboard tinted on both sides—Caledonian or Granit grey, for example—is recommended in preference to white as not being so readily soiled.

The sizes of the pieces used in the following exercise are such as can be cut with little waste from "roya sheets (*i.e.* sheets measuring about 24″ × 19″). It is bes to get them cut with a bookbinder's guillotine.

(*N*) *Small cutting knife.*—A special knife, with short, stou pointed blade about 2″ long, will be found the best fo use in cutting the cardboard. The handle, about 4 long, should be rounded, and of such a size that it ca be grasped firmly and comfortably by the hand of an ordi nary child. (Messrs. Philip, Son, and Nephew suppl special knives of the kind described.)

In cutting the cardboard the point of the blade should be used, the knife being held at a high angle, and kept close to the rule which is used to guide it along the



proper line. The rule must be held firmly in position by the fingers of the left hand.

) *Steel rule.*—A wooden rule must not be used for guiding the cutting knife, as the edge of the rule itself would be cut. Flat steel rules, 1″ broad and 12″ long, may be obtained at the tool-shops; but Messrs. Philip supply special steel rules 6″ long, which are more easily held in place by the children. It is scarcely necessary to add that both the knives and rules must be kept in a dry place to keep them from rusting.

) *Strips of bookbinder's cloth* are used for binding over the edges of the cardboard—in the case of the flat cardboard figures merely to give them a more finished appearance, but in the case of the models either to join adjacent cut edges or to strengthen those where the cardboard is partly cut through.

The cloth is fastened on with gum or thin liquid glue, and for class purposes it is best to buy it ready gummed on one side and cut into strips. A piece of cloth of the length of the edge to be bound is cut from the strip, folded carefully lengthwise down the middle (to enable it to be placed symmetrically over the edge), then moistened, placed on the cardboard, and held in position until it adheres firmly.

Cloth of various colours may be obtained, and with the surface smooth or variously marked. Dark blue cloth, *with a surface* roughened by points or cross-lines, looks

very well on the grey cardboard, but the colour is a run if moistened too much.

(*Q*) *Stout brown paper envelopes* are very convenient, being given to each child to contain its pieces of board, either when finished or in cases where an exe has to be left before it is quite completed.

EXERCISES IN WIRE MODELLING.

(EXERCISES I.—X.)

The first set of exercises in this series has for its object the construction of geometrical forms in fairly stout wire, by means of small flat pliers. (See *Notes K* and *L*, p. 130.)

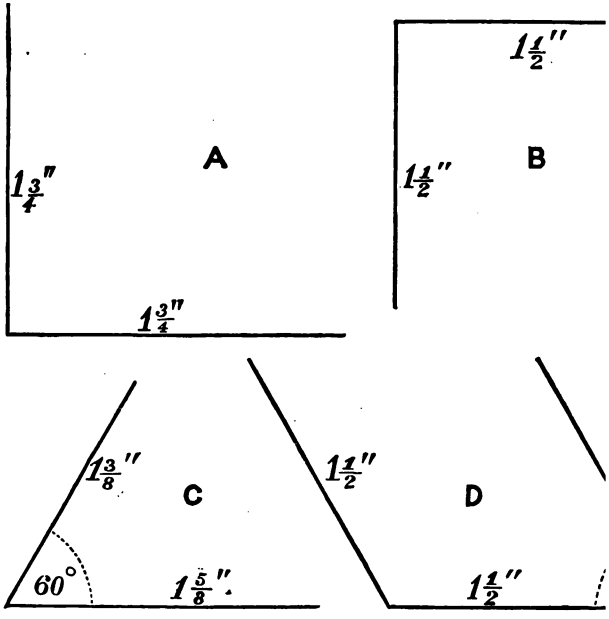
The forms to be constructed are first drawn accurately to scale by the children, on paper (either plain or squared), from a sketch on the blackboard having the dimensions marked. Each child should have his copy before him when constructing the figure in wire.

The wire may, perhaps, need to be first straightened out. The distances on the wire must then be accurately measured, and the bends carefully made at the proper points as sharply as possible. Care must be taken in bending the wire to see that all the parts when bent are as nearly as possible in one plane, so that the wire will lie *flat* on the paper over the drawn copy.

As the materials required, and the method of work, are very nearly the same for all the exercises in this set, it is not necessary to add a full description of each separate exercise. The diagrams are drawn full size, with the dimensions marked. A single piece of wire 12″ long is sufficient for each child, except in one or two exercises where two such pieces are required.

Exercise I.

WIRE MODELLING.

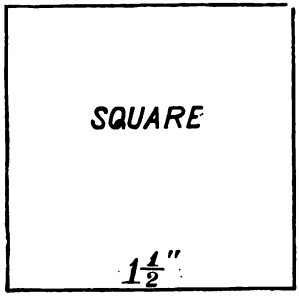


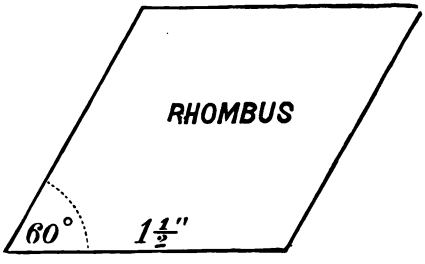
NOTE.—Calculate length of wire required for Fig. A; break off
proper length, and bend at right angles as shown. Then do t
for Figs. B, C, D.

(The angles in the drawings may be obtained by means of the set s

Exercise II.

WIRE MODELLING.



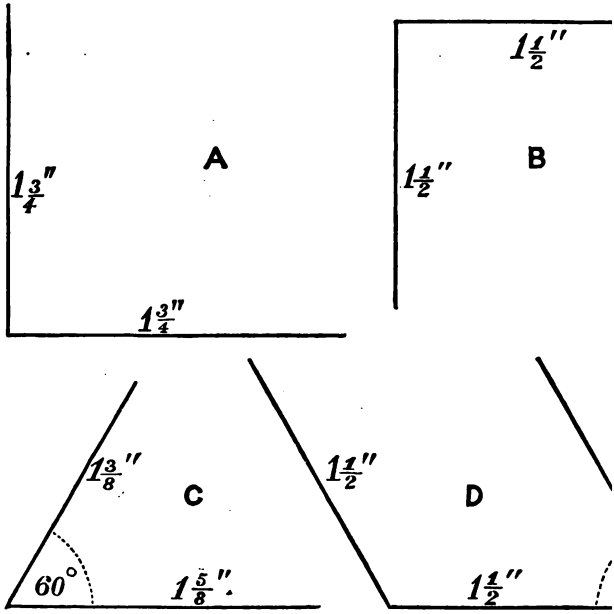


ɔTE.—Calculate length of wire required for each figure; break wire into lengths required, and construct figures.

terwards convert each wire figure into the other; *i.e.* the square into the rhombus, and *vice versâ.*

Exercise I.

WIRE MODELLING.

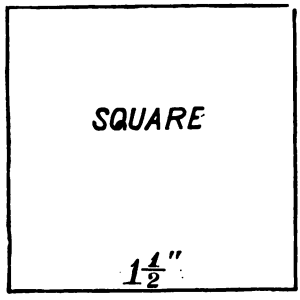


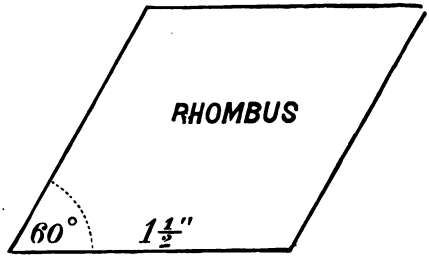
NOTE.—Calculate length of wire required for Fig. A; break off p
proper length, and bend at right angles as shown. Then do th
for Figs. B, C, D.

(The angles in the drawings may be obtained by means of the set sq

Exercise II.

WIRE MODELLING.



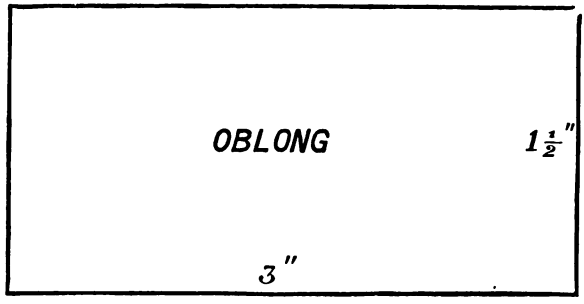


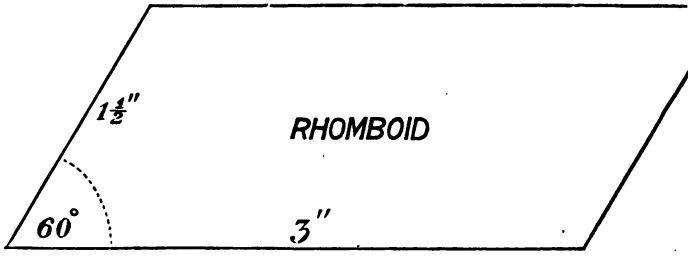
NOTE.—Calculate length of wire required for each figure; break wire into lengths required, and construct figures.

Afterwards convert each wire figure into the other; *i.e.* the square into the rhombus, and *vice versâ*.

Exercise III.

WIRE MODELLING.



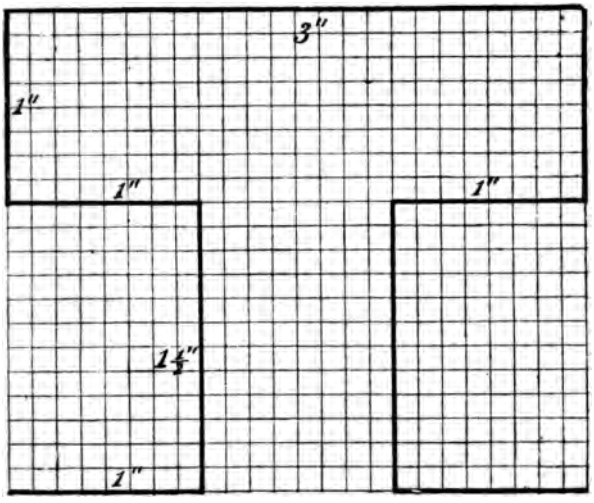


NOTE.—*Two* pieces of wire are required for this exercise. Calculate leng required for each figure, and break off.

After constructing figures in wire, convert each into the other, as in t last exercise.

Exercise IV.

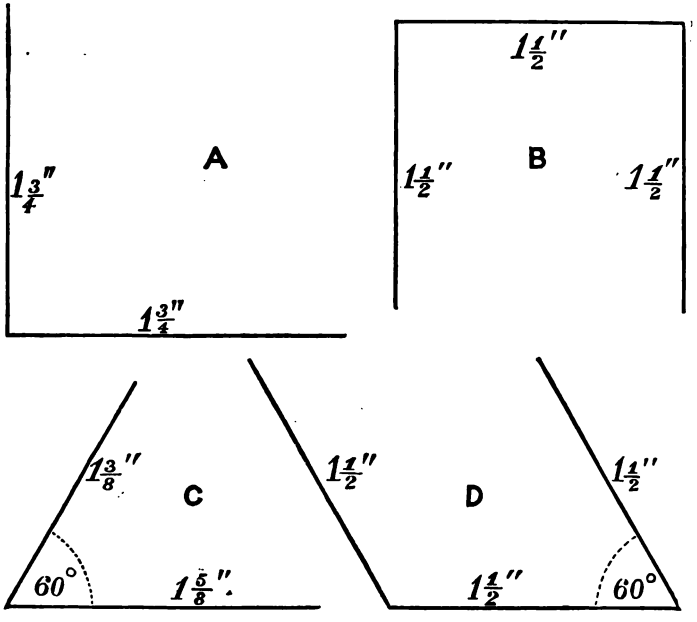
WIRE MODELLING.



NOTE.—This figure might be drawn on squared paper.

Exercise I.

WIRE MODELLING.

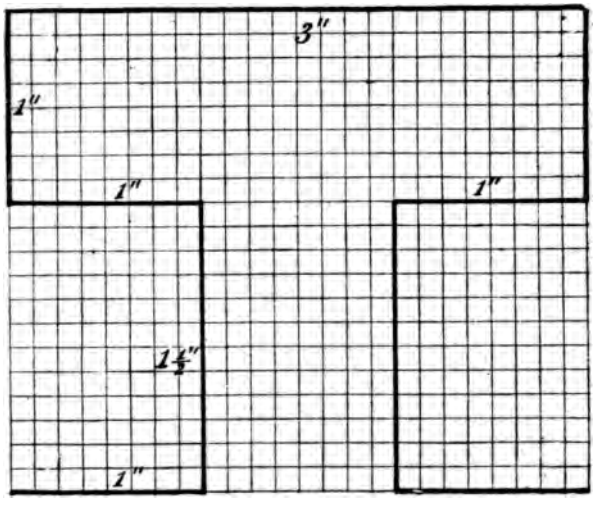


NOTE.—Calculate length of wire required for Fig. A; break off piece of proper length, and bend at right angles as shown. Then do the same for Figs. B, C, D.

(The angles in the drawings may be obtained by means of the set square.)

Exercise IV.

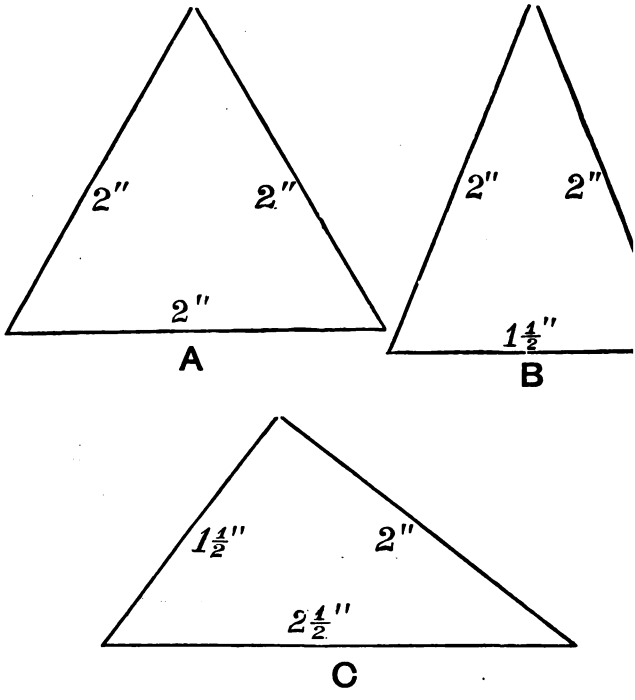
WIRE MODELLING.



NOTE.—This figure might be drawn on squared paper.

Exercise V.

WIRE MODELLING.

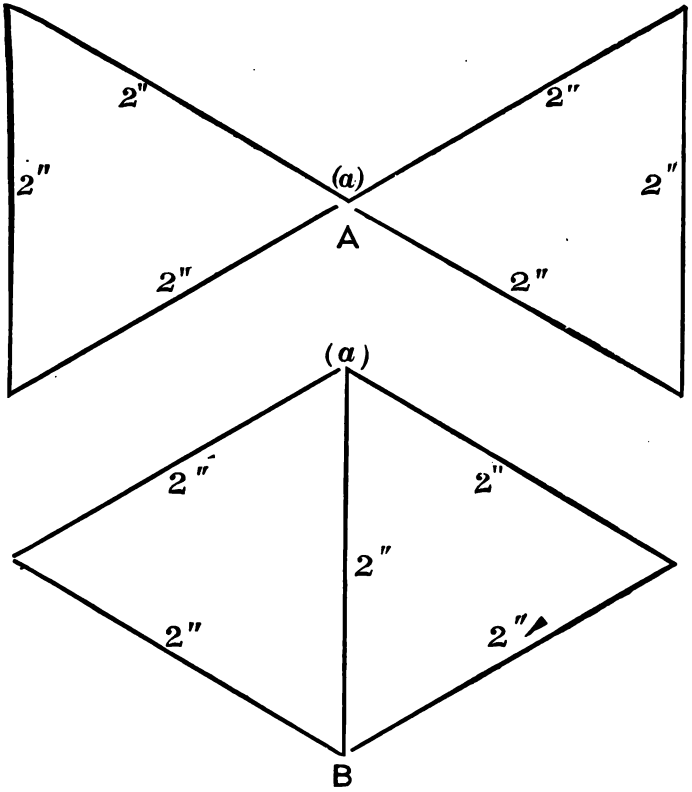


NOTE.—Draw the figures by means of rule and compasses.

Two pieces of wire are required.

Exercise VI.

WIRE MODELLING.

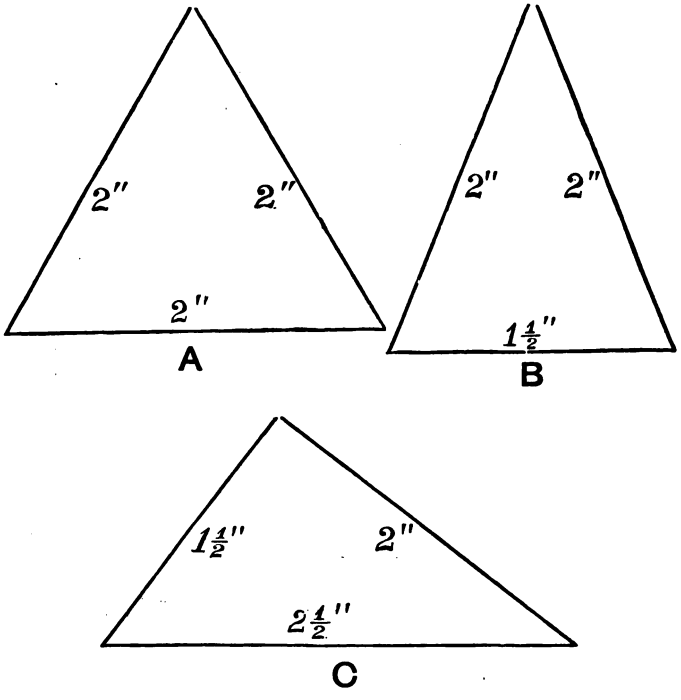


NOTE.—Draw one or both figures by means of compasses (or set square) and rule.

Two pieces of wire are required if each child constructs both forms. In constructing Fig. A, first find the middle point (*a*) of the wire, and commence bending there. For Fig. B the wire should first be broken to the proper length, then the position of point (*a*) found by measurement on the wire, and the bending commenced at that point.

Exercise V.

WIRE MODELLING.

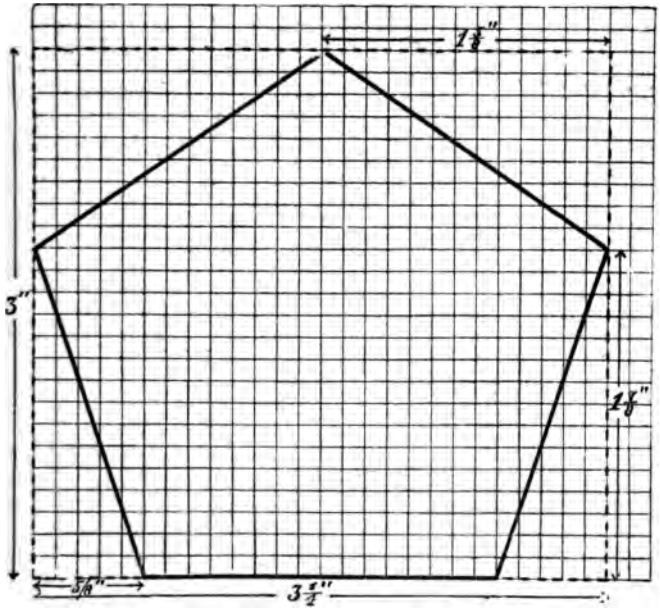


NOTE.—Draw the figures by means of rule and compasses.

Two pieces of wire are required.

Exercise VIII.

WIRE MODELLING.

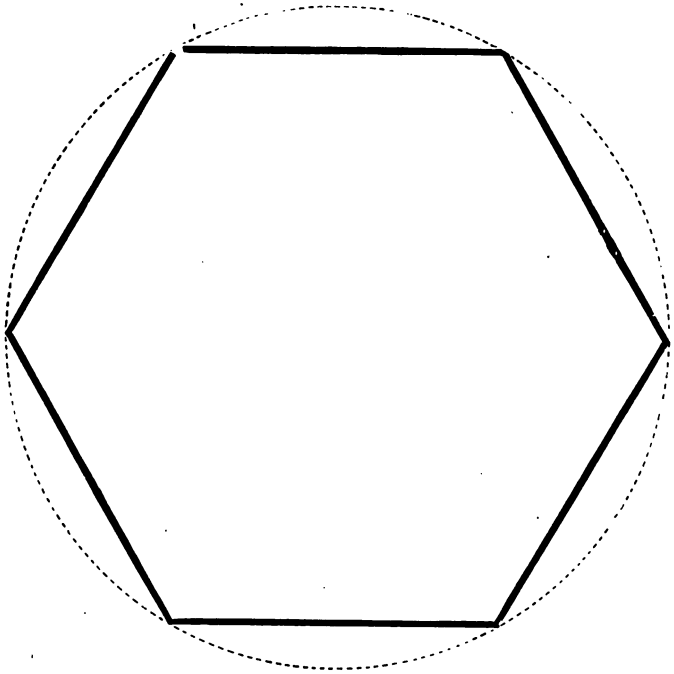


NOTE.—The figure (pentagon) should be drawn on squared paper, as an exercise in drawing to scale—the rectangular figure (dotted) being first drawn, then the points on the sides found, and the pentagon constructed by joining the points.

Before constructing the figure in wire, the lengths of the sides must be measured, and the total length of wire required be calculated.

Exercise VII.

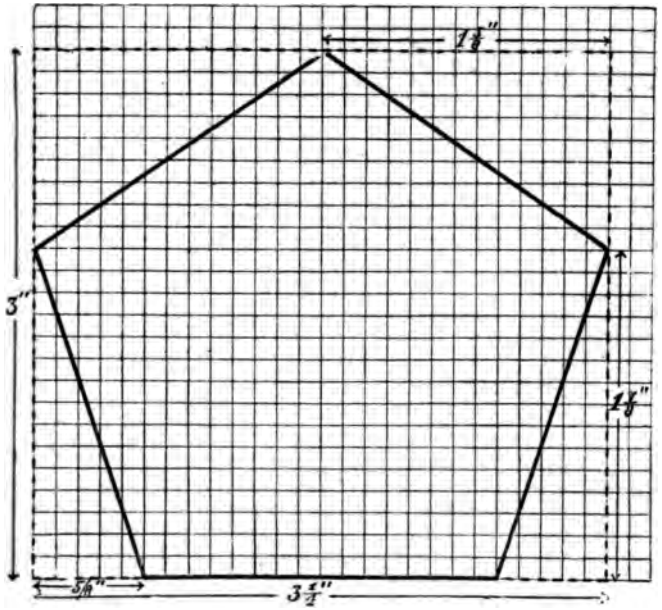
WIRE MODELLING.



NOTE.—Construct the hexagon in a circle by means of a pair of compassés.

Exercise VIII.

WIRE MODELLING.

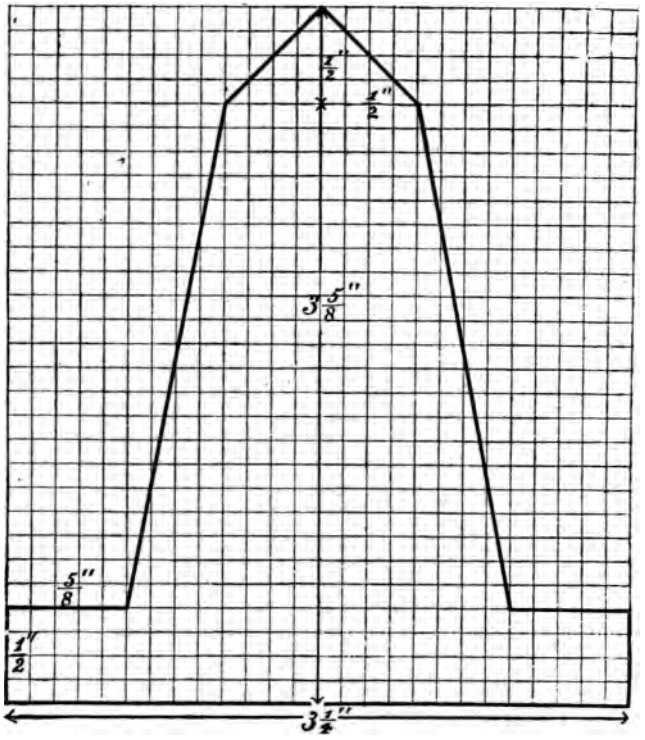


NOTE.—The figure (pentagon) should be drawn on squared paper, as an exercise in drawing to scale—the rectangular figure (dotted) being first drawn, then the points on the sides found, and the pentagon constructed by joining the points.

Before constructing the figure in wire, the lengths of the sides must be measured, and the total length of wire required be calculated.

Exercise IX.

WIRE MODELLING.

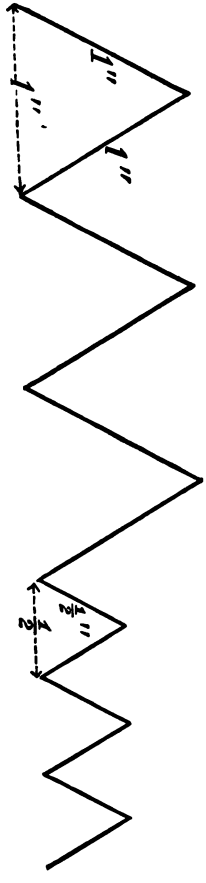


NOTE.—This figure also should be constructed as an exercise in drawing to scale, either on plain or squared paper.

The proper angles at which to bend the wire must be found by applying it to the drawing.

Exercise X.

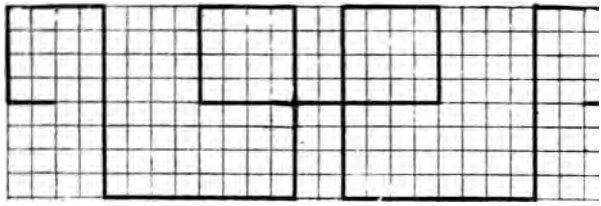
WIRE MODELLING.



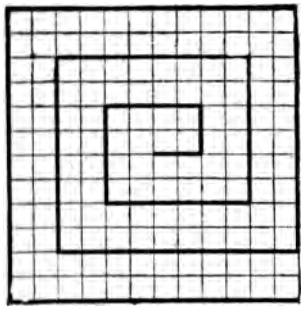
OTE.—This exercise should be constructed in wire without either measurement or application of the wire to the drawing. The parallelism of the various lines should be pointed out as a chief feature to be secured.

ie drawing may be made by means of the rule and set square.

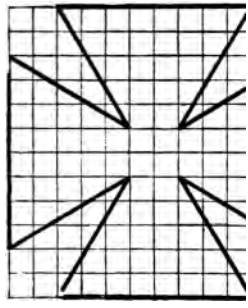
Additional Exercises in Wire Modelling.



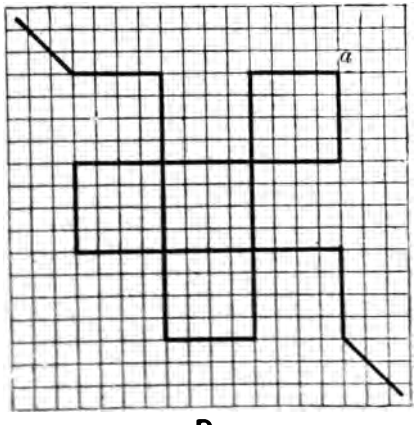
A



B



C



D

NOTE.—The figures are best drawn on squared paper.

In constructing Fig. D in wire, begin by bending wire at its middle p
and in B begin by bending wire to form central parts of figure.

EXERCISES IN CARDBOARD CUTTING.

(EXERCISES XI.—XX.)

THE second set of exercises in the present series deals with the cutting out of simple geometrical forms in cardboard with a sharp-pointed knife. (See *Notes M* and *N*, p. 190.)

The figures should first be accurately drawn in pencil on the cardboard (after having been previously practised on drawing paper, if necessary) by means of a ruler and set square or compasses, the drawing being done either from a verbal description or from a sketch on the blackboard, the actual dimensions being given in each case.

The cardboard to be cut should be laid on a smooth piece of board (or stout millboard), to save the desk from being cut. A steel rule (see *Note O*, p. 191) is firmly held close to the line along which the cut is to be made, and the point of the knife is then drawn along close to the rule. If the cardboard is not cut through completely the first time, care must be taken, in making a second or third stroke, to keep in the original groove.

In the figures of Exercises XVIII., XIX., etc., where a piece of cardboard has to be cut out from within an angle, it will be found best to make the cut *from*, and not *to*, the point of the angle.

Some or all of the figures cut out may have their edges bound with strips of coloured paper or bookbinder's cloth (see *Note P*, p. 191), which, if carefully done, will give them a more finished appearance. It is left to the teacher to choose which

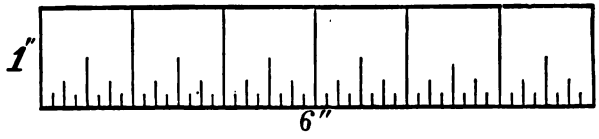
of the figures should be so bound; in some cases permis: to bind the model might be the reward for good work.

As the materials required and the method of work are same for all the exercises in the set, it is not necessary to g a full description of each exercise.

The figures given in the following exercises are, in nea all cases, drawn half the size indicated by the dimensic marked on them.

Exercise XI.

CARDBOARD CUTTING—SIX-INCH RULE.



'OTE.—Piece of cardboard 8″ × 6″.

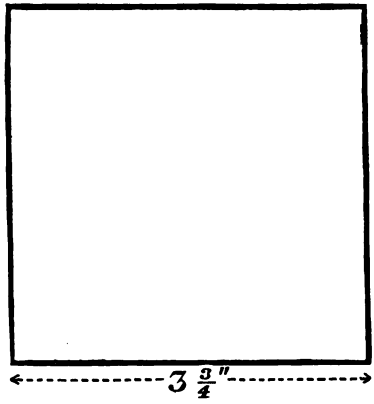
ut strip 1″ wide from *long* side of cardboard; then cut off piece 1″ long from each end (forming two inch-squares).

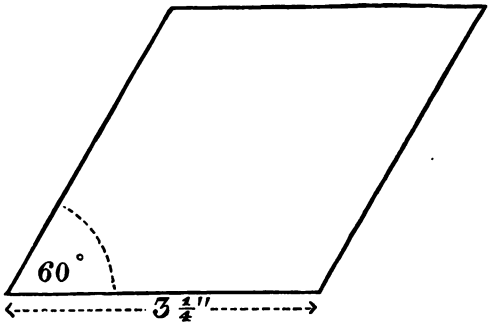
[ark strip with pencil successively into inches, half-inches, quarter-inches, and eighths.

[he remaining piece of cardboard will be used in the next exercise.]

Exercise XII.

CARDBOARD CUTTING—SQUARE AND RHOMBUS.

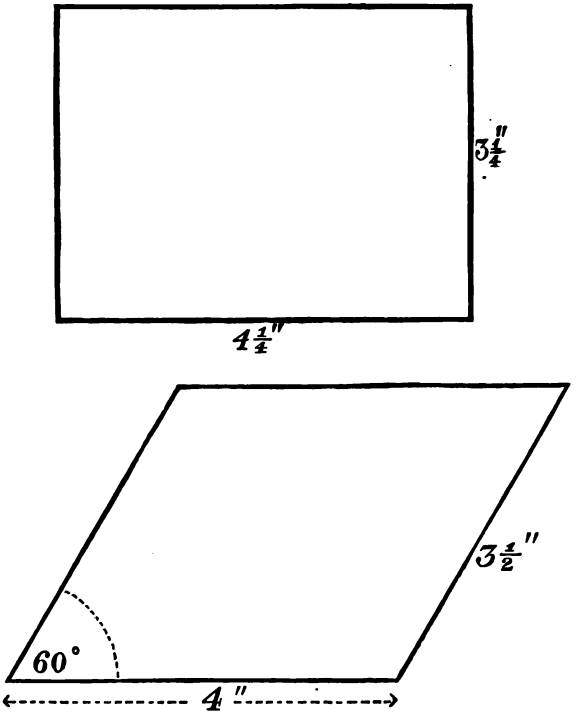




NOTE.—Use the piece of cardboard left over from the last exercise

Exercise XIII.

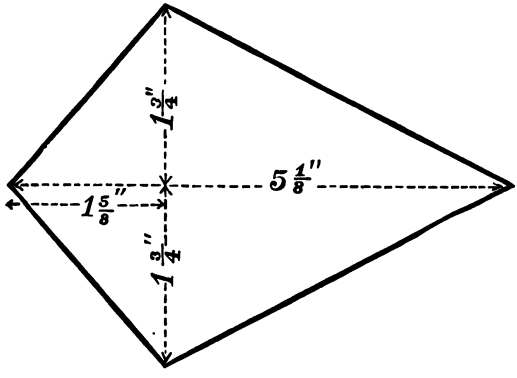
CARDBOARD CUTTING—OBLONG AND RHOMBOID.



NOTE.—Piece of cardboard 8" × 6'.

Exercise XIV.

CARDBOARD CUTTING—TRAPEZIUM.

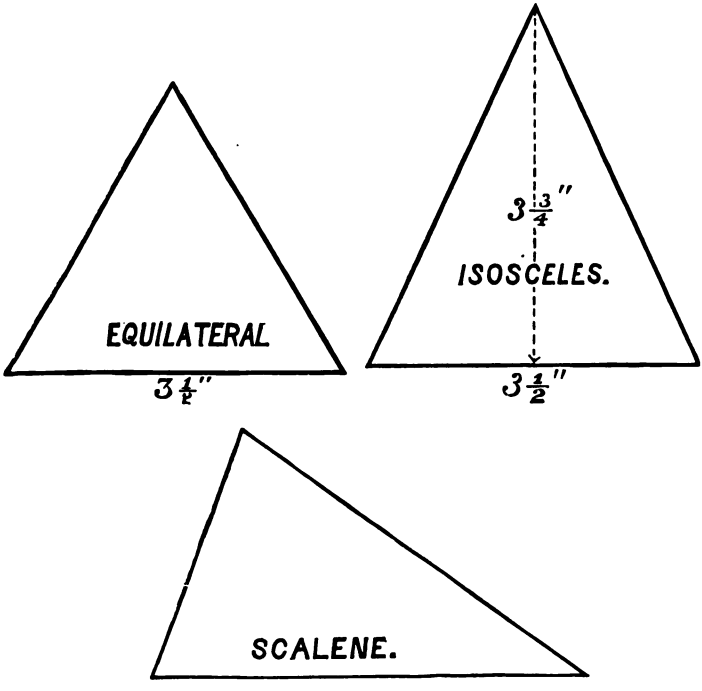


NOTE.—Piece of cardboard 6″ × 4″.

First draw the two diagonals at right angles to each other, and
length (longer one $5\frac{1}{8}''$, shorter $3\frac{1}{2}''$); then draw lines join
ends.

Exercise XV.

CARDBOARD CUTTING—TRIANGLES.

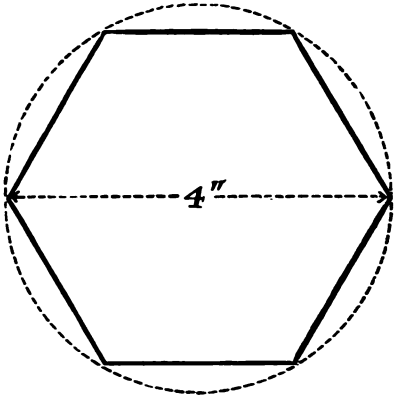


NOTE.—Piece of cardboard 8″ × 6″.

The scalene triangle might be cut out without being first drawn; and then the sides carefully measured, and the dimensions marked on the card.

Exercise XVI.

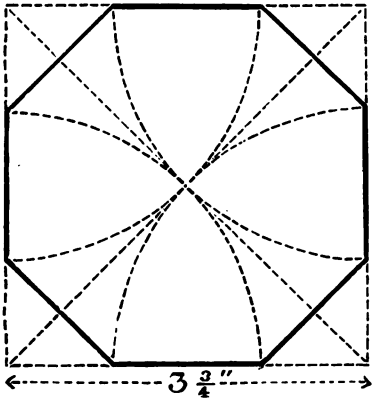
CARDBOARD CUTTING—HEXAGON.



NOTE.—Piece of cardboard 6″ × 4″.

Exercise XVII.

CARDBOARD CUTTING—OCTAGON.

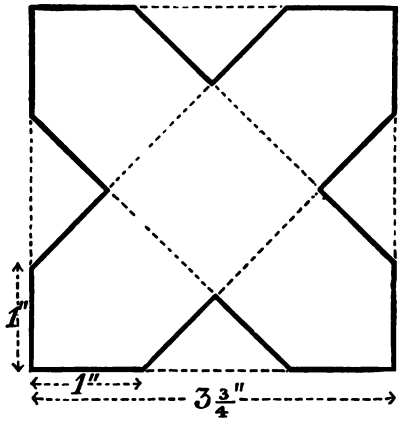


NOTE.—Piece of cardboard 6" × 4".

Construct octagon by first drawing square of $3\frac{3}{4}$" side, then drawing the diagonals, and with point of compasses on corners of square drawing arcs as shown in figure. Rule outline of octagon strongly before cutting.

Exercise XVIII.

CARDBOARD CUTTING—CROSS.



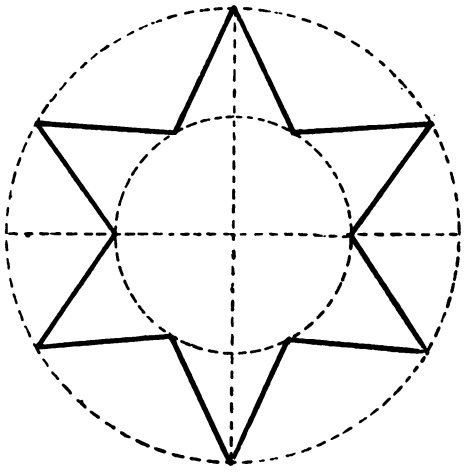
NOTE.—Piece of cardboard 6" × 4".

First draw a square of 3¾" side, mark off points 1" from corners of and complete figure as shown.

Cut out the complete square first, and then the V-shaped pieces fr sides, cutting *from* the point of the angle.

Exercise XIX.

CARDBOARD CUTTING—SIX-RAYED STAR.



NOTE.—Piece of cardboard 6″ × 4″.

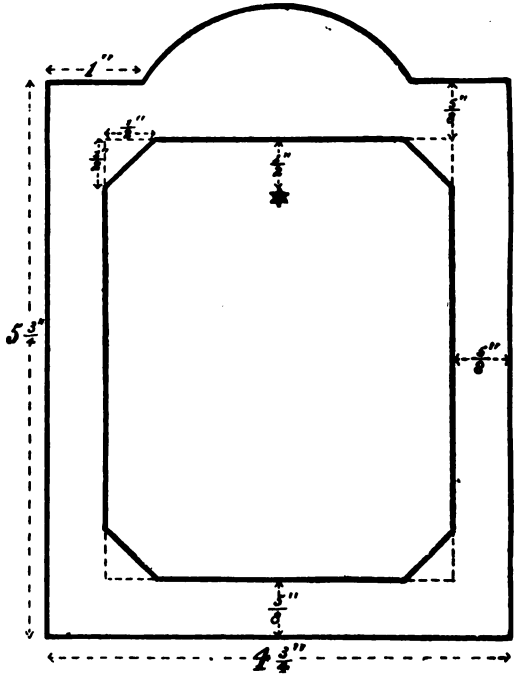
Draw outer circle 4″ diameter, inner circle 2″ diameter. Then draw two diameters at right angles.

Divide outer circle into six parts from end of one diameter, and inner circle into six parts from end of other diameter, as if about to construct hexagons.

Join points as in figure.

Exercise XX.

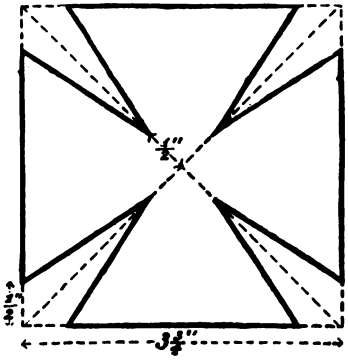
CARDBOARD CUTTING—PICTURE FRAME.

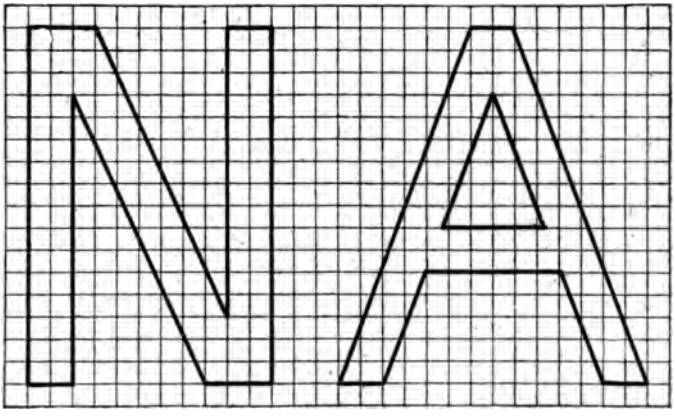


NOTE.—Piece of cardboard 8″ × 6″.

Strike curve for top of figure with compasses from point marked * as c
Cut out middle piece of cardboard as neatly as possible to leave a h
frame.

Additional Exercises in Cardboard Cutting.





NOTE.—Other letters, T, H, E, V, etc., might be cut out from the pieces of cardboard left over from Exercise XXXIII. and other exercises in cardboard modelling.

EXERCISES IN CARDBOARD MODELLING.

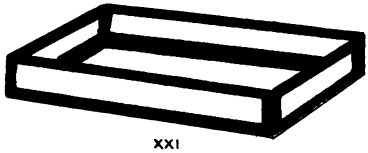
(EXERCISES XXI.—XXX.)

THE third set of exercises in this series deals with the construction in cardboard of models, or simple objects having a more or less solid form, instead of being, as in the last set, mere plane geometrical figures.

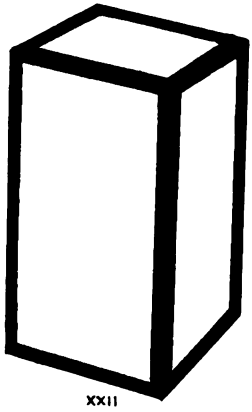
A plan, or "development," has first to be drawn upon the flat cardboard in such a manner that, when the cardboard is bent along certain lines shown on the plan, the model or object is produced. In order to enable this bending to be done accurately and neatly, the cardboard is cut half-way through (*on the face which is to form the* OUTER *surface of the model*) along the line on which it has to be bent; and care must be taken that the knife does not cut so deeply into the cardboard as either to sever it entirely or to leave too thin a layer connecting the two parts. In the following drawings the lines along which these partial cuts are to be made are dotted, while the continuous lines indicate where cuts passing completely through the cardboard are required.

To obtain well-made models and objects, it is essential that both the drawing and the cutting should be as accurate as possible.

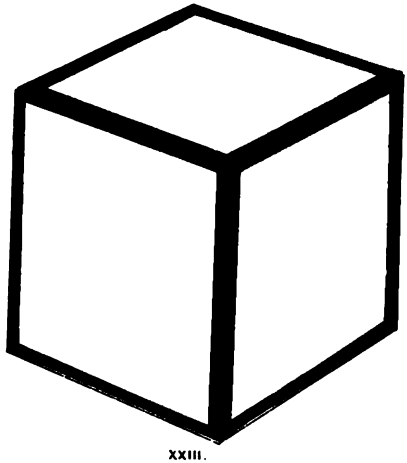
After having made the drawing to scale on the cardboard, showing the lines continuous or dotted as in the copy, the child should cut neatly through the *outer* lines of the drawing, so as to cut out from the sheet the piece of cardboard required for the model. Then the inner dotted lines should be half cut through—at first very lightly, and repeated until the proper *depth is* obtained. Then the cardboard should be carefully



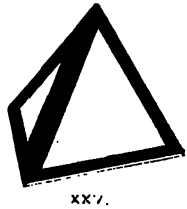
XXI



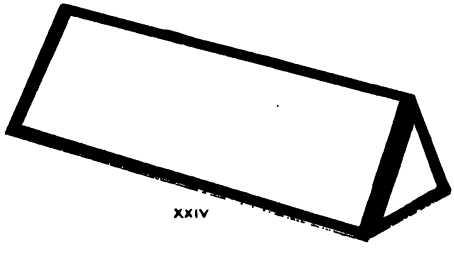
XXII



XXIII.



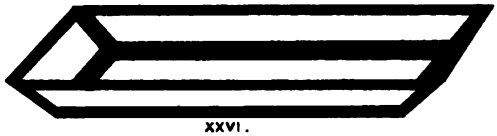
XXV.



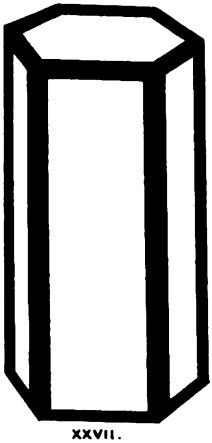
XXIV

THE NEW YORK
PUBLIC LIBRARY

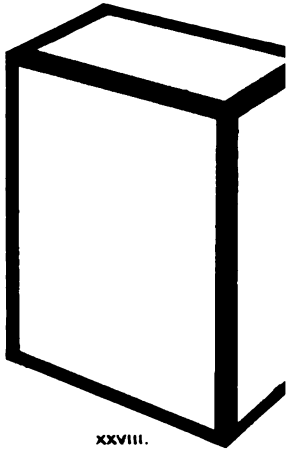
THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS.



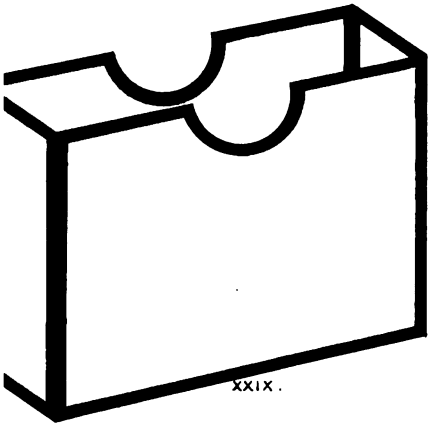
XXVI.



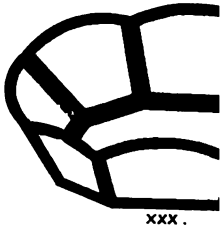
XXVII.



XXVIII.



XXIX.



XXX.

ent, where half cut, away from the side on which the cut has been made, and the cut edges, which come together in the model, joined by strips of gummed cloth. (See *Note P*, p. 191.) Other edges of the model may be similarly bound with strips of cloth, both for the sake of appearance and for additional strength.

Care and patience will be needed in binding the models, to produce nicely finished work. In some cases it may be found advisable to moisten and fasten down only half the width of the strip at one time; but in all cases it must be pressed neatly and firmly on the cardboard, and held in place until it properly adheres.

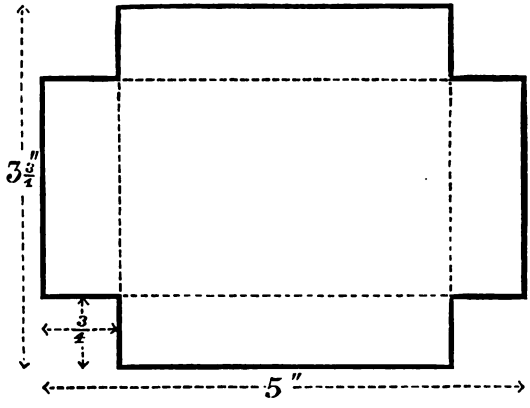
Some of the models might have their faces covered with the gummed coloured paper used in the exercises of the previous series, in which case the papering should be done before the models are bound.

The forms of the various cardboard models are shown on Plates IV. and V. Many other exercises in cardboard modelling might readily be arranged by the teacher; *e.g.* a simple wall-bracket, a sliding match-box, a box with hinged lid, etc.

The figures in the following exercises are not drawn full size, but the actual dimensions required are marked on the drawings.

Exercise XXI.

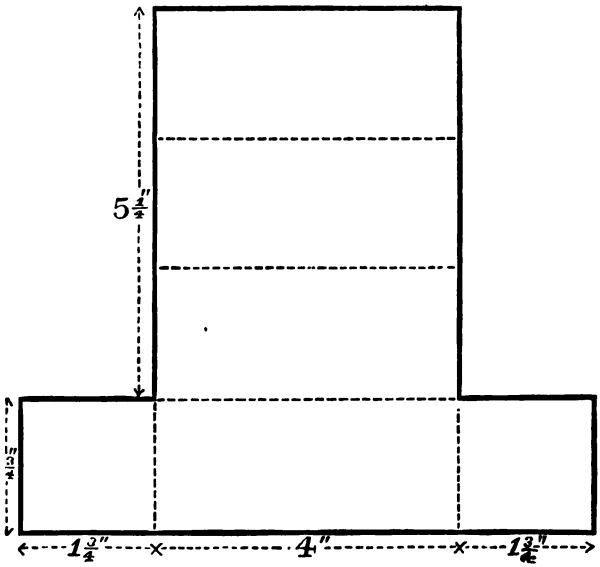
CARDBOARD MODELLING—RECTANGULAR TRAY.



NOTE.—Cut piece of cardboard required from end of piece 12" × 8" lay aside remainder for use in the next exercise.

Exercise XXII.

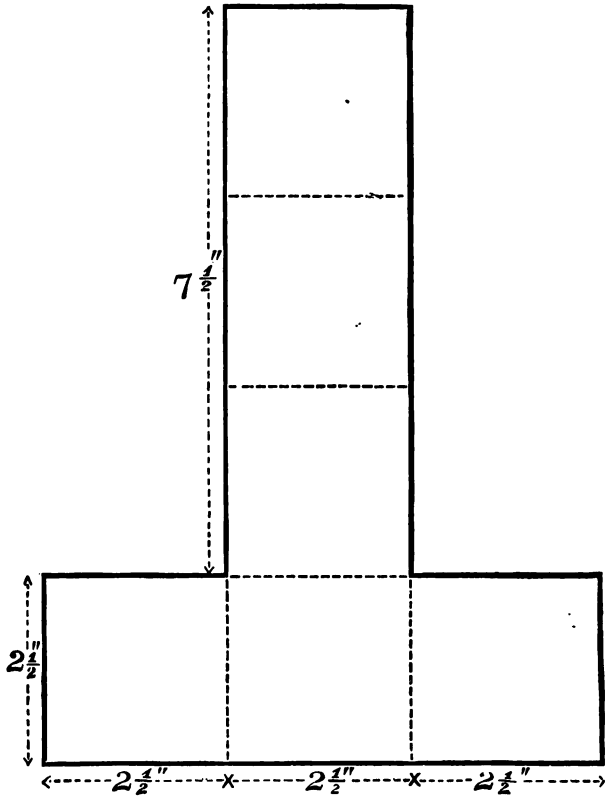
CARDBOARD MODELLING—SQUARE PRISM.



NOTE.—Use the piece of cardboard left from Exercise XXI.

Exercise XXIII.

CARDBOARD MODELLING—CUBE,

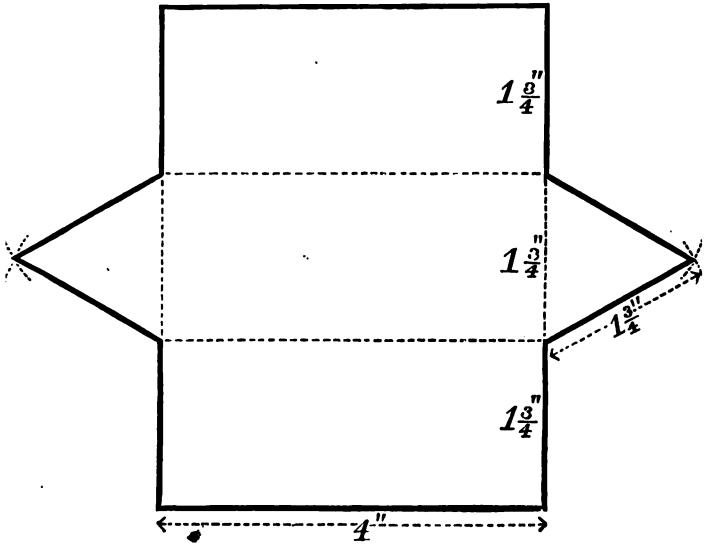


NOTE.—Piece of cardboard 12" × 8".

[The remaining pieces of cardboard might be used for cutting vari capital letters. (See p. 217)]

Exercise XXIV.

CARDBOARD MODELLING—TRIANGULAR PRISM.

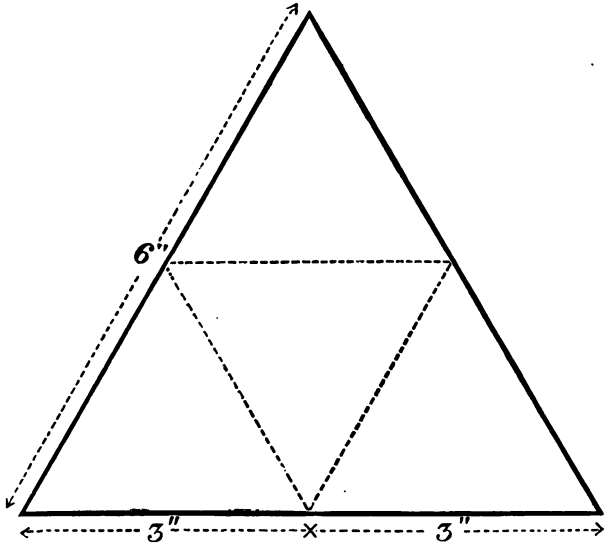


NOTE.—Piece of cardboard 8″ × 6″.

The triangles are equilateral.

Exercise XXV.

CARDBOARD MODELLING—TETRAHEDRON.

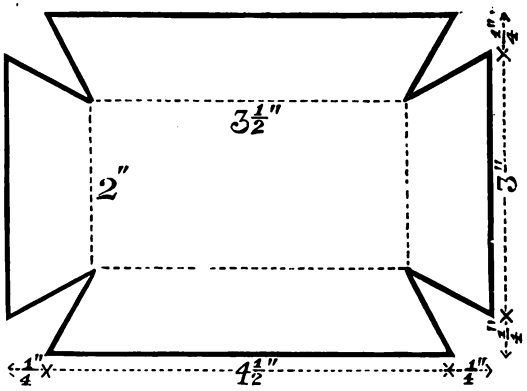


NOTE.—Piece of cardboard 8" × 6".

The large triangle is equilateral, and the dotted lines join the middle points of the sides, forming four smaller equal and equilateral triangles.

Exercise XXVI.

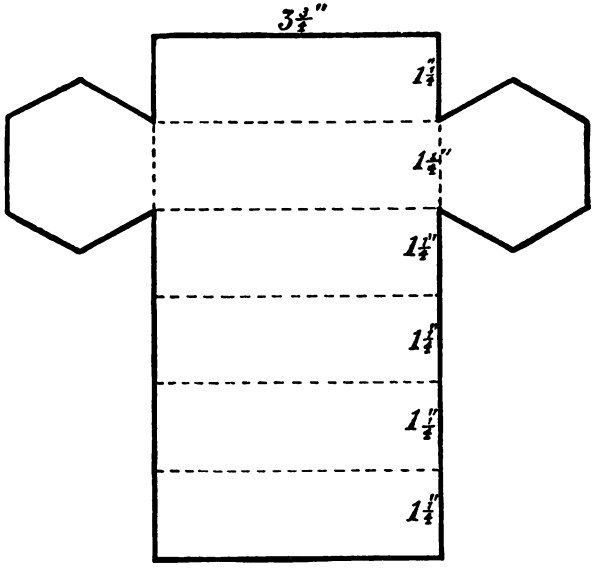
CARDBOARD MODELLING—TRAY WITH INCLINED SIDES.



NOTE.—Cut piece of cardboard required from end of piece 12″ × 8″, and lay aside remainder for next exercise.

Exercise XXVII.

CARDBOARD MODELLING—HEXAGONAL PRISM.

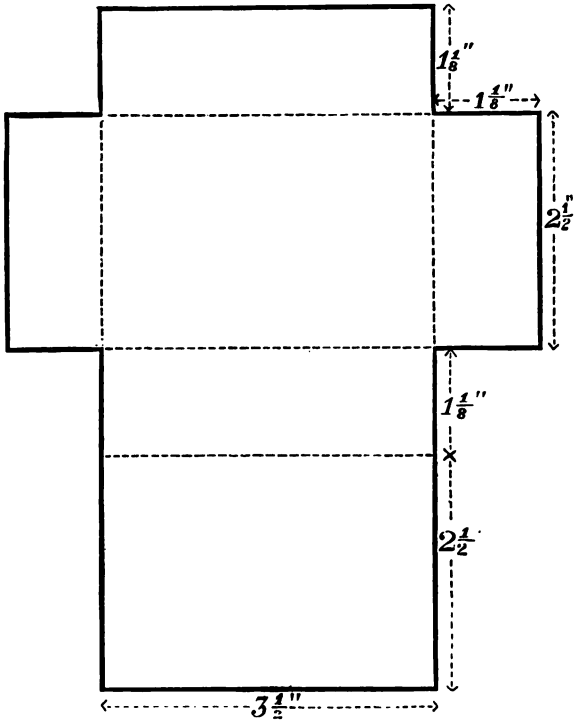


NOTE.—Use piece of cardboard left from Exercise XXVI.

Construct the hexagon at each side on any one of the shorter sides c rectangles, by first drawing the circumscribing circle, and then n ing off the points on the circumference.

Exercise XXVIII.

CARDBOARD MODELLING—RECTANGULAR PRISM.



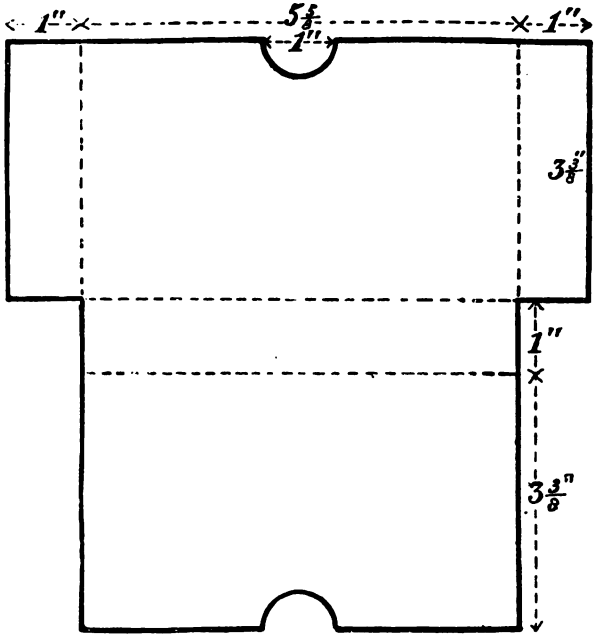
NOTE.—Piece of cardboard 8" × 6".

Point out, on previously constructed models, before the exercise is begun, how this prism differs from the square prism of Exercise XXII.

588915

Exercise XXIX.

CARDBOARD MODELLING—ENVELOPE CASE.

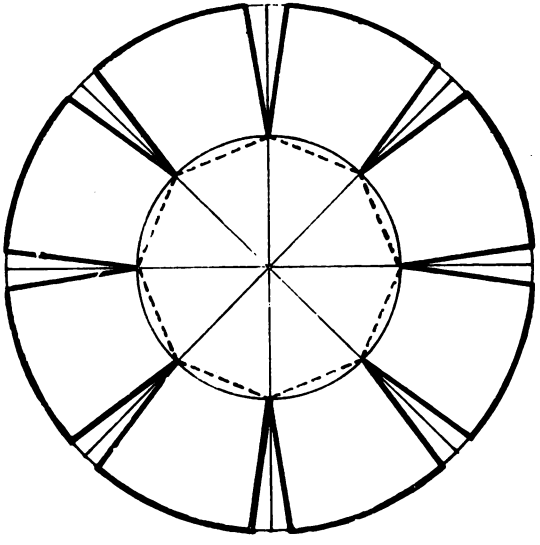


NOTE.—Piece of cardboard 12" × 8".

If the children find the semicircular notch too difficult to cut out neatly, square one may be substituted.

Exercise XXX.

CARDBOARD MODELLING—OCTAGONAL TRAY WITH INCLINED SIDES.



NOTE.—Piece of cardboard 8″ × 6″.

The construction lines used in drawing the pattern are shown by faint continuous lines in the illustration. The diameter of the outer circle is 5½″, of the inner 2½″. The small pieces cut out measure ¼″ on the outer circle.

The outer edges of the tray may be either curved, or, if the children find the cutting in that case too difficult, the edges may be ruled and cut straight.

3

N.7-